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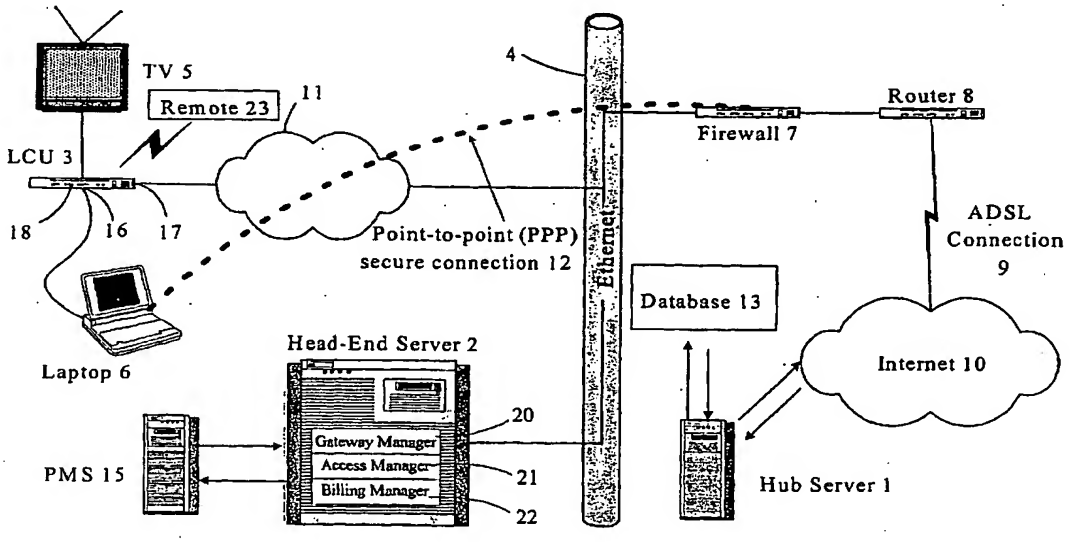
(54) Title: METHOD AND APPARATUS FOR DISTRIBUTING DATA




(57) Abstract: A system for distributing data is presented. Mediating means, such as a Local Control Unit (3) is adapted for connection to a processor, such as a Laptop (6). The Local Control Unit (3) mediates communication between a server, such as a Head End Server (2), and the Laptop (6). A method of distributing a first set of data (VID1) and a second set of data (VID2) is also presented. Portions of the first set of data (VID1(1), VID1(2)...) are interleaved with portions of the second set of data (VID2(1), VID2(2)...) and sent to a common Local Control Unit (LCU).



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# METHOD AND APPARATUS FOR DISTRIBUTING DATA

The present invention relates amongst other things to the distribution and networking of television, video and other signals.

Certain aspects of this invention find particular application in a media distribution/networking system for use in a multi-user or multi-room environment, or across a local network. Many of the embodiments as described herein (in any aspect or embodiment) are directed to systems within hotels and their installation and use. As used herein the term "hotel" is preferably to be understood as encompassing any form of establishment where guests are temporarily allocated a room or similar or part thereof, whether for payment or not. It should be understood that the embodiments, and the systems, methods and features, described herein are also readily installed and used within other environments, including, in particular ships, particularly cruise ships, aeroplanes, trains, hospitals, multi-dwelling units, for instance blocks of flats, or condominiums, groups of houses, offices or groups of offices, factories, shops or groups of shops, schools and other work, commercial or educational environments, stations, airports and other transport termini.

Conventional Local Area Networks (LANs) employ a central server and one or more processors distributed on the network. If a new processor is added to the network, it must be configured appropriately. This can be difficult if the server and processor use different communication techniques or protocols, or if information concerning the address or location or other characteristics of each of the server and the processor are not known to the other of the server and the processor.

Furthermore, in conventional systems communication with a user depends upon a new processor being successfully installed and or upon appropriate software operating at the processor. If any problems occur with adding a processor to the network or in operation of any part of the network it can be difficult or impossible to communicate with a user and thus to resolve any problems.

The billing of services connected with connection of a processor to a network also depends upon an ability to communicate with a user. This is particularly important in an environment where a user may only connect a processor to a network for a limited period of time and/or on a limited number of occasions.

The present invention seeks to ameliorate these problems, or at least to provide the public with a useful alternative.

A first aspect of the invention provides a system for distributing data, comprising mediating means and preferably a server, the mediating means being adapted for connection to a processor and to mediate communication between the server and the processor, preferably via a network.

By providing a mediating means, communication between the server and the processor can be more easily and efficiently established and maintained. The mediating means may, for instance, mediate communication between a processor and a server which are using different communication techniques or protocols, or the mediating means may mediate communication between a processor and a server even though information concerning the address or location or other characteristics of each of the server and the processor are not known to the other of the server and the processor.

As discussed herein, any means for carrying out a particular function may be in the form of a processor and associated memory, or in the form of an application installed in such a processor and associated memory.

The processor may suitably comprise any kind of electronic processor, for instance a computer such as a portable computer, particularly a laptop computer.

The mediating means may suitably comprise, for instance, a processor in particular any kind of electronic processor such as a computer or a set top box or local control unit, or may comprise an application installed on such processor.

Connections to and across the network may comprise electrical cable, for instance co-axial cable, or twisted pair cable, for instance data grade twisted pair cable, such as twisted-pair cable that substantially complies with or exceeds the specification of ANSI/EIA/TIA-568-1991, Category 3, or complies with or exceeds the specification of Category 5, or telephone grade twisted pair cable, or may comprise an electromagnetic radiation transmission path, for instance a microwave link, or any combination of such cable or such transmission paths.

The mediating means may perform an address faking procedure.

The terms "address faking" and "address masquerading" are used interchangeably herein.

The server and processor may be connected to the network by computer or cable interfaces, ports or connectors, for instance RJ-45 connectors, Ethernet connectors and ports, for instance 10Base-T Ethernet ports, and via serial ports and connectors, for instance D-type ports and connectors.

The data may be any type of electronic data, particularly digital data, for instance computer data, including computer programmes, text data, and or signals representative of audio/visual data, and may include data in a variety of compression formats, including MPEG-2, MPEG-4, MP3 protected by different ciphering algorithms including DVB-CS, DES, 3DES. The data may be transmitted according to a variety of different protocols or techniques, in particular IP protocol.

The term "audio/visual data" as used herein preferably connotes audio data, visual data, or a combination of the two.

The system may have particular application in environments where communication between the server and the processor has not previously been established or maintained, or where communication between the server and the processor may only be maintained temporarily.

Examples of environments where the system may have particular application include, for instance, environments where a user may wish to establish communication between a processor and a server for a limited period of time, and in particular, without reconfiguring the processor, or indeed the server. Examples of such environments include environments where a user may be transporting a processor, for instance a laptop or other portable computer, with them, and in particular include hotels, or indeed any hospitality environment, cruise ships, aeroplanes, trains, office environments, or any workplace or where a user may wish to establish communication between a processor and a server for a limited period of time.

The system may also have particular application in establishing communication between a processor and a range of different services or servers. Examples of environments where the system may have particular application include home environments, hospitality environments in particular hotels, where the processor may act as a gateway to many different services or servers, or workplace, particularly office environments, and different services or servers may include internet servers or portals, and also television, video, audio and other entertainment devices, games machines, desktop or laptop computers, databases, and production, measurement and control devices.

Preferably, the server is configured to distribute a first set of data and a second set of data to the mediating means by distributing portions of the first set of data interleaved with portions of the second set of data.

The first and second sets of data may comprise any type of data as described herein.

Preferably, the mediating means is configured to retransmit the portions of the first set data to a first output device and to retransmit the portions of the second set of data to a second output device.

Thus data may be output by first and second output devices at the same time, and or control or feedback operations may be carried out at the same time as data is output by one or both of the output devices.

Such first and second output devices may be any kind of audio/visual output device, for instance a television, audio player, computer, for instance a portable computer, electronic storage means, games processor, printer, or any kind of electrical or mechnical device.

Preferably, the mediating means is adapted to be responsive to a signal that is transmitted by the server over the network and addressed to the mediating means or to the processor, so that point-to-point communication is established between the server and the mediating means.

Preferably, the mediating means is further adapted to establish point-to-point communication between the server and the processor.

The point to point communication is preferably established by means of a dedicated communication protocol, such as IP protocol, particularly UDP/IP.

Preferably the system is a system for distributing data to different locations in a local network, preferably for distributing data to different rooms within a hotel, or different dwellings in a neighbourhood, or in hospitality environments such as cruise ships, or office or work environments.

Preferably, the mediating means comprises control means for controlling operation of the processor.

The control means may be a processor such as a computer, or an application installed on such a processor.

Thus, the mediating means may establish and maintain communication between the processor and the server in the most appropriate and efficient manner.

The control means may, for instance, change the configuration of the processor or provide data to the processor in order to enable establishment of communication with the server, if the server and the processor were initially configured incompatibly.

The control means may also request data from the processor, for instance status information, or an address, and this data may be used in control operations.

The control means may also be adapted to control a further device, for instance another processor, a display device such as a television, an audio player, a control unit, for instance a remote control unit, or a storage device.

The mediating means may route particular data to the processor or to the further device, in dependence upon characteristics of the data or of the devices or of user preferences. So, for instance, it may be possible for an internet connection to be established with the processor, and/or for internet information to be displayed on a television set. Thus, a user may browse the internet either via the processor, for instance, a laptop computer, or using information displayed on a display device, for instance a television set.

Preferably, the mediating means comprises means for assigning an address to the processor.

Thus, point-to-point communication may be established between the server and the processor even if the processor does not possess an appropriate address.

The address may be an IP address, or an address appropriate to any other computer communication or networking protocol.

Preferably, the means for assigning an address to the processor is configured to assign the address dynamically.

Thus, an address may be assigned in an efficient and flexible manner, and the most appropriate form of address may be chosen.

The means for assigning an address to the processor may alternatively located at the server, or a further means for assigning an address may be located at the server. Thus the server may be responsible for assigning an address to one or both of the server and processor.

The address thus assigned may be used to replace an existing address, or may be a new address.

Preferably, the means for assigning an address comprises a DHCP client.

Preferably, the mediating means is adapted to mediate communication between the server and a further device. Thus communication may be established and maintained easily and efficiently between the server and more than one device.

The further device may be another processor, a display device such as a television, an audio player, a control unit, for instance a remote control unit, or a storage device.

Preferably, the system further comprises monitoring means for monitoring communication between the server and the processor and/or the mediating means.

The monitoring means may be located at the server, or at the mediating means, or at some intermediate point. The monitoring means may monitor any errors which occur in transmission of data, or may monitor the type, quantity, or source of data distributed or any errors or omissions in distribution of such data.

The monitoring means may suitably comprise, for instance, a processor in particular any kind of electronic processor such as a computer or a set top box or local control unit, or may comprise an application installed on such processor.

Monitoring data may be stored, processed or output from the monitoring means and may be used in other applications. Such monitoring data may be used, for instance, to charge for services, or to improve the efficiency, speed or capacity of the system. Monitoring data may be communicated to a user, or may be used to generate information to be communicated to a user, for instance via a means for providing a display signal as aforesaid. Thus, error messages, billing information or usage information may be communicated to a user.

Preferably, the monitoring means is adapted to monitor the quantity of data transmitted between the server and the processor or mediating means and/or the duration of the connection between the server and the processor or mediating means. Thus, usage of the system may be monitored.

This important feature is provided independently, thus in a further aspect of the invention there is provided monitoring means adapted to monitor the quantity of data transmitted between a server and a processor or mediating means and/or the duration of the connection between the server and the processor or mediating means

Preferably, the monitoring means is adapted to monitor communication between the server and the processor and or the mediating means at regular intervals.

Preferably the system further comprises a billing manager for receiving monitoring information from the monitoring means and generating billing information in accordance with the monitoring information. The billing information can then be presented to a user, either on a display screen or in printed form.

The billing manager may suitably comprise, for instance, a processor in particular any kind of electronic processor such as a server, computer or a set top box or local control unit, or may comprise an application installed on such processor.

Preferably, the system comprises a billing manager for receiving monitoring information from the monitoring means, comparing the monitoring information with a stored billing parameter, and outputting a user message to the mediating means if the monitoring information breaches the stored billing parameter.

Preferably, the system comprises a billing manager for receiving monitoring information from the monitoring means, and maintaining a cumulative record of usage based on the received monitoring information, the cumulative record of usage including a user identifier which associates the record with a particular user.

Preferably, the system further comprises means for providing a display signal for displaying information concerning communication between the server and the processor, and preferably for displaying information obtained from the monitoring means.

Thus, information may be communicated to a user concerning communication between the server and the processor.

Preferably, the server is adapted to distribute audio/visual signals, and the mediating means is adapted to receive the audio/visual signals. Unless the context indicates clearly otherwise, the term "audio/visual" is used in this specification to mean audio and/or visual. Thus the system may enable distribution of audio/visual signals and distribution of data, in an efficient manner, using at least some of the same components.

The mediating means may be adapted to store audio/visual signals, and/or to transmit the audio/visual signals, for instance to the processor, or to another device.

Such other device may be an output device, for instance an audio/visual output device.

The system may be an entertainment or information system adapted to distribute, for instance, terrestrial or satellite television programmes, or video-on-demand, music, or other content.

The system may be adapted to distribute other signals as well as, or instead of, audio/visual signals.

Preferably, the mediating means is adapted to receive the audio/visual signals and to mediate communication between the server and the processor simultaneously.

Preferably, the means for providing a display signal is adapted to display audio/visual signals received by the mediating means.

Thus, audio/visual signals and data may be distributed rapidly and efficiently. Also, a user may be able to access and or update both audio/visual signals and data simultaneously.

Thus, for instance, a user may surf the internet using a computer connected to the mediating means, at the same time as they can listen to music or watch a film on a television also connected to the mediating means.

Preferably, the server is adapted to transmit data in response to a request for data, preferably from the processor or mediating means, and preferably on command of a user.

Preferably, the server comprises control means adapted to compare the request with control criteria and to distribute data in dependence upon that comparison.

Thus it may be possible to control, for instance, the type, quantity or source of data which is distributed. It may be possible to control, for instance, access to particular internet pages, if an internet connection is established from the processor (in the form for instance of a computer, particularly a laptop computer) or mediating means (in the form, for instance, of a set top box) via the server. This may have particular application in an environment such as a hotel, where it would be possible to control which internet pages or other information may be accessed by a guest.

The request for data may come from the mediating means, or from the processor.

Preferably, the server is adapted to receive data and to distribute the data, preferably to the mediating means or to the processor.

Thus, data may be distributed from a wide variety of sources such as a further server, an external database, or the internet, and may be transmitted to the server by a variety of means, for instance by cable, satellite, internet connection, or telephone line.

The data may be stored and or processed at the server before distribution.

Preferably, the server and mediating means are configured to support communication between the server and processor according to a network address translation (NAT) protocol.

This is a cost-effective and robust solution which enables the processor to perform a variety of functions, such as 'surfing' the internet, use of FTP, e-mail and will support streamed media content .

Preferably, the server and mediating means are configured to support communication between the server and processor according to a tunnelling protocol.

This enables the mediating means to support more complex applications such as Virtual Private Networks (VPN), video conferencing applications, and other applications that require complex addressing.

Preferably, the tunnelling protocol comprises the L2TP tunnelling protocol.

This protocol is particularly suited to supporting a VPN.

Preferably, the system further comprises means for receiving a connection request from the processor, comparing the connection request with conditional access criteria, and connecting the processor with the server or an external network interface if the connection request complies with the conditional access criteria.

Preferably, the mediating means is configured to receive a connection request from the processor, to compare the connection request with conditional access criteria, and to connect the processor with the server or an external network interface if the connection request complies with the conditional access criteria.

This enables the processor to be connected (for instance with the internet) according to a conditional access protocol. For instance the processor may only be connected if a guest associated with the processor has subscribed to a connectivity service. The conditional access criteria may also be, for instance, a list of allowed or disallowed internet sites, and it would thus be possible to control, for instance, which sites a user may be able to connect to.

Preferably, the system comprises an external network interface for connecting the server and/or processor with an external network.

The external network interface enables communication with an external network such as the internet.

Preferably, the system comprises a session manager for initiating and terminating a communication session between the processor and the external network interface

The session manager enables the communication session to be managed centrally – for instance terminating the session if a user's subscription expires during a session.

The session manager may suitably comprise, for instance, a processor in particular any kind of electronic processor such as a computer, particularly a server, or a set top box or local control unit, or may comprise an application installed on such processor.

Preferably, the session manager is configured to notify the monitoring means at the beginning and/or end of the communication session.

This provides an interaction between the session manager and the monitoring means, enabling accurate session monitoring to be carried out.

Preferably, the session manager is configured to terminate the communication session if there is no communication between the processor and external network interface for a predetermined time period.

Thus, a user may avoid being charged if a communication session is unintentionally prolonged. Further, this also enables unused system resources to be freed for another user.

Preferably, the session manager is configured to receive a connection request from the processor, determine whether a connection with the external network interface is available, initiate a communication session if a connection is available, and output a message if a connection is not available.

Preferably, the system further comprises a display for displaying messages to a user.

The message may be a message to a user, for instance output through a television or other device connected to the mediating means. Thus a user can be informed of the status of a connection request, of the progress of a communication session, of billing or other information.

The display may be controlled by the processor and/or by the mediating means.

Preferably, the mediating means is configured to cause the display to display messages when the mediating means is not connected to the processor, enabling instructions to be displayed to a user prior to connection. For instance the mediating means may be configured to cause the display to display connection messages which indicate one or more steps to be taken by a user to connect the processor to the mediating means. For instance the messages may instruct a user to attach a serial or Ethernet cable between the mediating means and the processor. Alternatively the mediating means may be configured to cause the display to display disconnection messages which indicate one or more steps to be taken by a user to disconnect the processor from the mediating means.

Preferably, the mediating means comprises a real-time operating system for controlling streaming video.

Preferably the system further comprises means for intercepting messages, and performing address translation on the intercepted messages.

Such address translation may be address faking or masquerading or may be included in such an address faking or masquerading process.

Preferably, the mediating means is configured to intercept messages between the processor and the server, and to perform address translation on the intercepted messages.

Preferably, the system further comprises one or more additional mediating means, each configured to intercept messages between a respective processor and the server, and to perform address translation on the intercepted messages.

Preferably, the server is configured to intercept messages between the processor and an external network, and to perform address translation on the intercepted messages.

Preferably, the server is configured to map an address of the processor to another address by Network Address Translation (NAT).

Preferably, the address translation comprises IP address translation.

Preferably, the mediating means comprises a real-time operating system including a proxy IP server for mapping an IP address of the processor to an IP address of the mediating means.

Preferably, the mediating means comprises a real-time operating system including a DHCP client for dynamic allocation of an IP address to the mediating means.

Preferably, the mediating means comprises a real-time operating system including an NFS client to allow the mediating means to connect to a network file system through the server.

Preferably, the mediating means comprises a real-time operating system including an analogue to digital converter for receiving a digital stream from the server, converting the digital stream to an analogue stream, and routing the analogue stream to an analogue output device.

Preferably, the analogue output device is a television.

Preferably, the mediating means is adapted to mediate communication between the processor and the server via a Virtual Local Area Network (VLAN).

In a further aspect of the invention there is provided a mediating means adapted to mediate communication between a server and a processor, preferably via a network.

Preferably, the mediating means is configured to intercept messages between the processor and the server, and to perform address translation on the intercepted messages.

Preferably, the address translation comprises IP address translation.

Preferably, the mediating means is adapted to be responsive to a signal that is transmitted by the server over the network and addressed to the mediating means or to the processor, so that point-to-point communication is established between the server and the mediating means.

Preferably the mediating means is further adapted to establish point-to-point communication between the server and the processor.

Preferably, the mediating means further comprises control means for controlling operation of the processor.

Preferably the mediating means further comprises means for assigning an address to the processor.

The means for assigning an address may suitably comprise, for instance, a processor in particular any kind of electronic processor such as a computer, for instance a server, or may comprise an application installed on such processor.

Preferably, the means for assigning an address to the processor is configured to assign the address dynamically.

Preferably, the means for assigning an address comprises a DHCP client.

Preferably the mediating means is further adapted to mediate communication between the server and a further device.

Preferably the mediating means further comprises monitoring means for monitoring communication with the server and/or the processor and/or between the server and the processor.

Preferably the monitoring means is adapted to monitor the quantity of data transmitted between the server and the processor or mediating means and/or the duration of the connection between the server and the processor or mediating means.

Preferably the monitoring means is adapted to monitor communication with the server and/or the processor and/or between the server and the processor at regular intervals.

Preferably the mediating means further comprises means for providing a display signal for displaying information concerning communication between the server and the processor, and preferably for displaying information obtained from the monitoring means.

Preferably the mediating means is further adapted to receive audio/visual signals.

Preferably the mediating means is further adapted to receive audio/visual signals and to mediate communication between the server and the processor simultaneously.

Preferably the mediating means is further adapted to display the audio/visual signals on a display means, and to display information relating to communication between the server and the processor on the display means.

Preferably the mediating means is further adapted to transmit a request for data to the server, in dependence upon a request for data received from the processor.

Such a request for data may be a request for an address, such as an IP address, to be assigned to the processor, or indeed to the mediating means itself, or may be a request for content, for instance audio/visual data, or internet content.

Preferably the mediating means further comprises monitoring means for monitoring communication with or between the server and the processor.

Preferably the mediating means is configured to support communication between the server and processor according to a network address translation (NAT) protocol.

Preferably the mediating means is configured to support communication between the server and processor according to a tunnelling protocol.

Preferably the tunnelling protocol comprises the L2TP tunnelling protocol.

Preferably the mediating means is configured to receive a connection request from the processor, to compare the connection request with conditional access criteria, and to connect the processor with the server or an external network interface if the connection request complies with the conditional access criteria.

Preferably the mediating means is adapted for connection to a display, and to cause the display to display messages when the mediating means is not connected to the processor.

Preferably, the mediating means is configured to cause the display to display connection messages which indicate one or more steps to be taken by a user to connect the processor to the mediating means.

Preferably, the mediating means is configured to cause the display to display disconnection messages which indicate one or more steps to be taken by a user to disconnect the processor from the mediating means.

Preferably, the mediating means comprises a real-time operating system for controlling streaming video.

Preferably, the mediating means comprises a real-time operating system including a proxy IP server for mapping an IP address of the processor to an IP address of the mediating means.

Preferably, the mediating means comprises a real-time operating system including a DHCP client for dynamic allocation of an IP address to the mediating means.

Preferably, the mediating means comprises a real-time operating system including an NFS client to allow the mediating means to connect to a network file system through the server.

Preferably, the mediating means comprises a real-time operating system including an analogue to digital converter for receiving a digital stream from the server, converting the digital stream to an analogue stream, and routing the analogue stream to an analogue output device.

Preferably, the analogue output device is a television.

In a further aspect of the invention there is provided a mediating means adapted for connection to a processor and to a server and to change the address of a message transmitted between the server and the processor, such that the message appears to originate from the mediating means.

In another aspect of the inventions there is provided a mediating means adapted for connection to a processor and to a server and to change the address of a message transmitted from the processor to the mediating means in order to direct it to the server.

Preferably, the mediating means is further adapted to send a request to the processor to ascertain its address, and to change the address of any message originating from that address.

In a further aspect of the invention, there is provided a method of managing communication between a processor and a server, the method comprising mediating communication between the server and the processor with a system or mediating means according to any of the preceding claims.

In another aspect of the invention, there is provided a network comprising a plurality of systems as aforesaid; and a central hub for transmitting data to the systems.

Features of the server, the mediating means, and the processor as aforesaid, may be implemented in any of the server, the mediating means, and the processor, singly or jointly, in any appropriate combination.

A further aspect of the invention is now described, which provides at least one of the following features in combination one with another:- a mediating means, a system for distributing data, a server, a processor, a control means, a display means, a mediating means, an interface, a receiver, connection of laptop via LCU, and communication with user via television, no browser needed to communicate with guest, control of laptop by LCU, assignment of address, preferably IP address to laptop by LCU, simultaneous distribution of content via LCU to two devices, connection of laptop via LCU and simultaneous distribution of content to, for example, a television via an LCU, billing of laptop connection as function of time connected or as function of quantity of data transferred, control of content which can be viewed on laptop connected to internet via LCU, connection to Virtual Private Networks, imitation of laptop by LCU.

The Laptop Connectivity service provided by the system allows hotel guests to use their personal laptop computer to access content and services delivered across the Internet. This enables guests to "surf" the Internet or to use the Internet as a communications path to the firewalls that control access to the guest's corporate network.

In a further aspect of the invention, there is provided a method of distributing a first set of data and a second set of data, comprising distributing portions of the first set of data interleaved with portions of the second set of data.

Thus a plurality of sets of data may be distributed simultaneously.

Such a method is particularly suitable for implementation using systems described herein, and in conjunction with methods described herein.

The first set of data may be a particular piece of content, for instance a film, and the second set of data may be another piece of content, for instance another film.

Alternatively, the first set of data and the second set of data may be data of different types, for instance any two of audio/visual data particularly digital television/video signals, text data, still images, moving images, Electronic Program Guides (EPGs), games, computer data particularly computer programmes or internet data and/or in different formats and/or subject to different encryption methods.

The portions of the first data set and the portions of the second data set may be interleaved temporally within a data stream. For instance, each portion of the first data set may be transmitted in a respective one of first set of packets, and each portion of the second data set may be transmitted in a respective one of a second set of packets, the packets being, for instance, IP packets. The packets containing the first portions of data, and the packets containing the second portions of data may be interleaved temporally within a data stream.

Upon receipt, for instance at a receiver, the portions of the first set of data may be processed to form the first set of data, and/or the portions of the second set of data may be processed to form the second set of data.

Alternatively, the portions of the first set of data and/or the portions of the second set of data may be retransmitted, for instance to an output device. For instance, if the first set of data contains audio/visual data representing a film, each packet containing a portion of the first set of data may

be received at a receiver, for instance, a set top box, and then streamed to a display device, for instance a television, in real time, whilst simultaneously each packet containing a portion of the second set of data, for instance another film, a piece of music, or internet data, may be received at the receiver, and streamed to another output device, for instance a television, a speaker, or a computer in real time. Thus simultaneous real time streaming of multiple sets of audio/visual data distributed over a single channel may be achieved.

Preferably, the first and second sets of data are both distributed to the same device.

Preferably, the portions of the first set of data and the portions of the second set of data each contain an address identifying the device.

Preferably, the method further comprises labelling the portions of the first set of data; and labelling the portions of the second set of data.

Preferably, the method further comprises interrupting distribution of the first set of data during an interruption period; distributing portions of a third first set of data interleaved with portions of the second set of data during the interruption period; and resuming distribution of the first set of data at the end of the interruption period.

Preferably, distribution of the first set of data is resumed in response to user input.

Preferably, the method further comprises receiving the portions of the first set of data and retransmitting the portions of the first set of data to a first output device; and receiving the portions of the second set of data and retransmitting the portions of the second set of data to a second output device.

Preferably, the method further comprises receiving the portions of the first set of data and streaming the portions of the first set of data in real time to a first output device.

Preferably, the method further comprises receiving the portions of the second set of data and streaming the portions of the second set of data in real time to a second output device.

Preferably the method further comprises receiving and storing the first and second sets of data prior to distribution.

Typically the method further comprises dividing the stored data sets into respective portions. Thus, the size of the portions can be selected as desired.

Typically the method further comprises outputting the first set of data from a first output device; and simultaneously outputting the second set of data from a second output device. Thus, the data can be output simultaneously on a first device (such as a laptop), and a second device (such as a television).

Preferably, the method further comprises outputting portions of the first set of data from a first output device, and simultaneously outputting portions of the second set of data from a second output device, so as to give the impression to a user that the portions of the first set of data and the portions of the second set of data are received simultaneously.

Preferably, the method further comprises receiving and outputting a first portion of the first set of data on an output device, and subsequently receiving and outputting a second portion of the first set of data on the output device, such that there is a continuous output of the first set of data on the output device.

A further aspect of the invention provides a method of distributing data to a plurality of control units, the method comprising distributing a first set of data and a second set of data to a first one of the control units on a first channel by a method according to the previous aspect of the invention; and distributing a third set of data and a fourth set of data to a second one of the control units on a second channel by a method according to the previous aspect of the invention.

In a preferred embodiment the functions of the mediating means according to the first aspect of the invention, and the control units according to the further aspect of the invention, are each provided by a Local Control Unit (LCU).

A further aspect of the invention provides a method of distributing data comprising transmitting first and second sets of data from a central hub to a plurality of local servers; storing the first and second sets of data at each local server; and distributing the first and second sets of data from at least one of the local servers by distributing portions of the first set of data interleaved with portions of the second set of data.

In a further aspect of the invention, there is provided a method of distributing a first set of data and a second set of data, comprising distributing portions of the first set of data interleaved with portions of the second set of data.

Thus a plurality of sets of data may be distributed simultaneously.

Such a method is particularly suitable for implementation using systems described herein, and in conjunction with methods described herein.

The portions of the first set of data and the portions of the second set of data are preferably distributed across the same channel.

The first set of data may be a particular piece of content, for instance a film, and the second set of data may be another piece of content, for instance another film.

Alternatively, the first set of data and the second set of data may be data of different types, for instance any two of audio/visual data particularly digital television/video signals, text data, still images, moving images, EPGs, games, computer data particularly computer programmes or internet data and/or in different formats and/or subject to different encryption methods.

The portions of the first data set and the portions of the second data set may be interleaved temporally within a data stream. For instance, each portion of the first data set may be transmitted in a respective one of a first set of packets, and each portion of the second data set may be transmitted in a respective one of a second set of packets, the packets being, for instance, IP packets. The packets containing the first portions of data, and the packets containing the second portions of data may be interleaved temporally within a data stream.

Upon receipt, for instance at a receiver, the portions of the first set of data may be processed to form the first set of data, and/or the portions of the second set of data may be processed to form the second set of data.

Alternatively, the portions of the first set of data and/or the portions of the second set of data may be retransmitted, for instance to an output device. For instance, if the first set of data contains audio/visual data representing a film, each packet containing a portion of the first set of data may be received at a receiver, and then streamed to a display device, for instance a television, in real time, whilst simultaneously each packet containing a portion of the second set of data, for instance another film, a piece of music, or internet data, may be received at the receiver, and streamed to another output device, for instance a television, a speaker, or a computer in real time. Thus simultaneous real time streaming of multiple sets of audio/visual data distributed over a single channel may be achieved.

In a further aspect of the invention, there is provided a system configured to distribute data by a method according as aforesaid, the system comprising a server for distributing the data, and one or more units for receiving and processing the data.

There is also provided a system configured to distribute data by a method as aforesaid, the system comprising a central hub; a plurality of local servers for storing and distributing the data; and one or more units for receiving and processing the data.

There is also provided a computer program adapted to carry out a method as aforesaid, and a computer readable medium having stored thereon such computer program.

Further preferred features of the invention will now be described, purely by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram of a media distribution/networking system;

Figure 2 is a more detailed schematic diagram of the media distribution/networking system of Figure 1;

Figure 3 is a more detailed schematic diagram of a variant of the media distribution/networking system of Figure 1;

Figure 4 is a flow chart showing the navigation through the options and messages which are presented to a guest in the Laptop Connectivity section of the system;

Figure 5 is a flow chart describing key processes and decision points when establishing a connection between the laptop and the Internet;

Figure 6 is a flow chart describing key processes and decision points whilst there is an active session between the laptop and the Internet;

Figure 7 is a flow chart describing key processes and decision points when terminating the connection between the laptop and the Internet;

Figure 8 is a flow chart describing key processes and decision points that relate to billing, whilst there is an active session between the laptop and the Internet;

Figure 9 is a block diagram illustrating the components with which the Gateway Manager communicates;

Figure 10 is a schematic diagram showing two video files being interleaved during transmission over a common channel; and

Figure 11 is a schematic diagram showing four video files being interleaved during transmission over two separate channels.

**1. Overview of system**

The media distribution/networking system shown in Figure 1 supports the reception of data streams from a central hub server 1. The central hub server 1 provides data streams to one or more sites 50 remote from the hub server 1, and the data streams provided to the sites can be tailored to the requirements of the site.

Although only one site is shown in Figure 1, it will be understood that in most cases the hub server 1 delivers data to more than one site.

In the preferred embodiment, the data streams are transmitted by a satellite transmitter 52 from the hub and received by a satellite receiver 54 at each site.

Upon receipt at a site, the data streams are processed and stored at a Head End Server (HES), which controls distribution of data streams to Local Control Units (LCUs) 3 at particular locations, for instance particular rooms, within the site.

The system of Figure 1 is illustrated in more detail in Figure 2.

In the preferred embodiment a back channel is also provided from the HES at a site to the hub server 1 via an Ethernet network 4, firewall 7, router 8, Asymmetric Digital Subscriber Line (ADSL) 9 and the Internet 10. In alternative embodiments such internet link is used to distribute data streams from the hub to the sites in place of, or as back up to, the satellite link.

Although only a single LCU 3 is shown in Figure 1 and Figure 2, it will be appreciated that in general a large number of LCUs will be connected to each HES. For instance, in a hotel there would typically be a network of LCUs, with one LCU located in each guest room.

A variant of the preferred embodiment is shown in more detail in Figure 3. The switched point-to-point digital distribution network 11 employs an internet protocol (IP) and in particular the user datagram protocol (UDP/IP). In an equipment room 116, the downlead 120 from the terrestrial television aerial 118 feeds a receiver and MPEG encoder 152 which provides digital MPEG video streams 154 for the received terrestrial television programmes to a server 2 (although one server 2 has been shown in the drawing, several such servers may be employed). Also, the downlead 124 from the satellite dish 122 feeds a decoder/descrambler 158 which provides digital MPEG video streams 160 for the received satellite television programmes to the server 2. Furthermore, the video replay equipment 162 has a digital output and provides digital

MPEG video streams 164 for the video programmes to the server 2. The server 2 selects which of the video streams is to be transmitted to which room 112, and places the selected video streams on the digital network 11 using UDP/IP, or TCP/IP, each addressed to the selected room 112. In each room 112, the television 114 is connected to the network 11 by a local control unit (LCU) 3 that receives the video stream addressed to that room 112, decodes it, and supplies the resulting analogue video and audio signals to the television 5. Each LCU 3 is also operable to send requests over the network 138 to the server 2, for example to change the television/video channel supplied to that LCU 3.

The network 11 is designed to support a bandwidth of up to 10 Mbps for communication between the server 2 and each LCU 3. The components required to deliver this bandwidth will vary because of the different topology of each hotel - for example, the layout of floors, risers, and the location of the equipment room 116 in which the server(s) 2 is/are situated.

The required bandwidth of 10 Mbps per LCU 3 can be delivered using a switched network built on one or more high speed (100 Mbps) switches 168 each having up to twenty three ports, for instance eleven ports, that are in turn linked to the server(s) 2 (and to each other) via a Gigabit switch or high speed backbone network linking switches 170. Each LCU 3 is connected to the network via such a 100 Mbps switch 168 and a Category 5 (ANSI/EIA/TIA-568-1991) unshielded twisted pair (UTP) cabling system 172 operating at up to 10 Mbps. Each switch 168 is connected to the backbone 174 using such a Gigabit switch 70 and a Category 5 UTP cabling system 176 operating at up to 100 Mbps. The server(s) 2 is/are connected directly to the Gigabit switch 170.

This architecture can be simplified for smaller installations that do not have high bandwidth requirements, by using 10/100 Mbps switches with fewer ports, and by using a lower speed cabling system for the backbone network.

Connections between the HES 2 and LCUs 3 may be established, in various embodiments, via cabling, in particular Category 3, Category 5, telephone, or coaxial cabling, microwave or other electromagnetic wave linkage, satellite transmission, bluetooth, and combinations of these media. In certain environments, for instance within trains, connection between the HES 2 and LCUs 3 may be established by means of radio links rather than, or in particular embodiments in conjunction with, cabling.

In the preferred embodiment data is transmitted between the HES and an LCU using User Datagram Protocol (UDP/IP). In alternative embodiments other communication protocols are

used, particularly other point to point communication protocols.

Each LCU is connected to at least one device, usually at least a television 5 or other display device. The LCU is also adapted to receive user input from a remote control unit 23. A user may thus control operation of a device attached to the LCU, or may communicate with the HES, for instance in order to request particular data or content.

The HES compares the data request with control criterion, to determine for instance whether the requested data is available, and whether the user is allowed to access that data.

The LCU mediates communication between the HES and devices connected to the LCU.

In the preferred embodiment, the HES receives a variety of data, including audio/visual data either from the Hub or from some other source such as the internet or terrestrial television or radio broadcasts, and distributes this data to LCUs. The LCUs generally output such received data to an associated device, for instance a television.

An LCU processes some such received data before outputting the data to an associated device. For instance, in the preferred embodiment the data transmitted between the HES and an LCU is digital data, and any digital audiovisual data transmitted between the HES and LCU would typically be converted to analogue audiovisual data before being output to a television associated with the LCU.

In the preferred embodiment, the HES also transmits control and information messages to LCUs. Such messages, for instance EPGs, may be generated by the HES.

**1.1 LCU**

In the preferred embodiment, each LCU 3 has a main Ethernet port 17 and communicates with the HES 2 via a communication path 11 and Ethernet network 4. Each LCU 3 also has a guest Ethernet port 16 and serial port 18 which enable a guest to plug in their laptop 6. In Figure 1, for illustrative purposes the laptop 6 is shown connected to the guest Ethernet port 16. Each LCU 3 is connected to a respective television set 5. The laptop 6 communicates with the firewall 7 via a point-to-point (PPP) secure connection 12. For the avoidance of doubt, the point to point secure connection 12 shown in Figure 1 does not represent a direct physical connection between the laptop and the firewall; rather this point to point secure connection is established via the LCU 3 and the communication path 11. A remote control unit 23 provides user input commands to the

LCU 3.

Two network interfaces are provided within the LCU 3: one to communicate with the Head-End Server (HES) 2 and one for the guest to plug-in their laptop 6. The network connection between the LCU and the HES is via a 10Base-T Ethernet network 4 that runs at 10Mbps using an RJ-45 connector, into which a Cat-5 twisted pair cable is connected. Two different methods are provided to allow a guest to access the Internet via the hotel's "high speed" Internet gateway; a serial port 18 and a 10Base-T Ethernet port 16.

- The 10Base-T port 16 runs at 10Mbps and the laptop is connected using a Cat-5 cable plugged into an RJ-45 port on the TelePort. The port is wired up as per a hub, so that cross over cables are not needed
- The serial port 18 is a 9-way female D-type connector, which supports a connection speed of 115.2Kbps.

The laptop 6 connects to the system using a TCP/IP protocol (over either IEEE 802.3 Ethernet for the 10BaseT connection 16 or PPP for the serial port 18).

**1.2 Head-End Server**

Although the HES 2 is illustrated in Figure 1 and Figure 2 as a single server, it will be understood that the HES 2 is a logical server that may be installed as one or more physical servers depending, for instance, on the number of LCUs 3 to be serviced, which in turn may be dependent, for instance, upon on the number of rooms in a hotel.

Within the HES are three server applications: the Access Manager 21, the Billing Manager 22 and the Gateway Manager 20.

The Access Manager 21 controls all of the services offered by the system, including access control permissions to services for each guest. The Billing Manager 22 controls all aspects of billing for the services used by guests. The Gateway Manager 20 controls and monitors each connection between a laptop attached to the LCU and the firewall that connects the hotel to the Internet via the ADSL connection. The Gateway Manager also passes connection and usage based data to the Billing Manager for processing. The Gateway Manager will:

- Ensure that packets are routed securely to their inbound or outbound destination
- Manage the sessions, including initiation and termination

- Monitor traffic flows and collect statistics.

### 1.3 Firewall

In the preferred embodiment, a firewall 7 is provided. The ability to route all Laptop Connectivity sessions to the Internet through one IP address reduces costs and increases security.

Content and related information, including films, music, software and software upgrades, still images, EPGs or information relating to EPGs, games and applications is stored in databases 13 connected to the hub server 1. Distribution of content to sites is controlled by the hub server 1.

Information relating to content, usage of content and distribution is received, stored, and processed at the hub, and sent to sites as appropriate. In particular, the databases 13 connected to the hub server 1 store information relating to content and content files and EPGs, such as title, status, digitisation status, ordering information, preparation information, licence information, running time, category, file size, filename, artist, genre, core album status, language, file id, file status, supplier, quality control status. Such information can be modified by the hub server 1.

Other information stored in the databases 13 includes site or hotel details, including location, id, city, telephone number, system details, configuration files, pricing, and update details.

Links between the hub server 1 and hotels or other sites enable information concerning content usage and other information to be transferred between the hub server 1 and the hotels or other sites. Such information includes content available at particular hotels or other sites, total and available storage capacity, information relating to available content, channel information, and usage information, either aggregate or individual, for instance on a per room, per stay, per guest, per hotel, or per time period basis. Such data is stored and processed by the hub server 1 and databases 13.

The HES 2 is coupled to a Property Management System 15.

Aspects of the system relating to laptop connectivity are now described, beginning with some basic requirements for obtaining laptop connectivity, and methods of communicating with a user. Flowcharts illustrating actions performed by various parts of the system upon connection of a laptop, termination of a connection, and billing a user are then discussed. There follows a more detailed discussion of operations performed by the HES and the LCUs, particularly IP address

faking. Finally, there is a comparison of IP address faking with standard Network Address Translation (NAT) protocol.

## 2 Laptop Connectivity

A Laptop Connectivity service provided by the system allows hotel guests to use their personal laptop computer 6 to access content and services delivered across the Internet 10. This enables guests to "surf" the Internet or to use the Internet as a communications path to the firewalls that control access to the guest's corporate network.

### 2.1 Introduction

The requirements for the Laptop Connectivity service, the platform provided by the system that will provide the service, and the "guest experience" when using the service are now described.

#### 2.1.1 Guest

The features from the guest's perspective are as follows.

- A variety of classes of content are supported:
  - Audio and video streaming
  - E-mail (POP3 and IMAP4)
  - Instant Messaging
  - IP Telephony
  - Newsgroups
  - Protocols (FTP and Telnet)
  - Video Conferencing
- Connectivity between the laptop 6 and the LCU 3 is via a TelePort, which has an RJ-45 socket to support an Ethernet connection, or via a D9 socket for a serial connection
- Guests are able to use VPN software of their choice to gain access to their corporate networks
- The guest is able to access the service from any port in the hotel, including their room. The guest may be required to enter a PIN number or to enter their room number. In addition, the LCU 3 needs a TV 5 connected to it so that a Laptop Connectivity application (stored by the LCU) can communicate with the guest.

The guest is able to access the internet through the laptop 6 connected via the LCU 3, whilst at the same time viewing or accessing other content received through the LCU 3, for instance films, television, games, audio, and messages.

The applications which the user may wish to run on the laptop and which access the internet fall into three broad categories with respect to their architecture and the way they access content on the Internet. The first category of applications use a browser to interact with the content; for example, pure web browsers such as Internet Explorer™ or Netscape Navigator™, or streaming content applications such as Real Player v8™ or Media Player™ which are browser based and the user can enter URLs to select the source of the content they require. The second category covers standalone applications that provide no browser interface but allow the user to enter Uniform Resource Locators (URLs) through the application; examples are FTP™, Telnet™, Real Player v7™, Real Jukebox v2™. The final category covers standalone applications that have no browser interface and control the URLs and IP addresses that the user can gain access to; examples are all AOL™ services, all VPN applications and applications that provide secure connections, and video conferencing applications such as Net Meeting™.

In the preferred embodiment, there is no need for a guest to use a browser, or an application with an in-built browser, in order for communication to be established with the guest, as display and input devices are supplied. Relying on the presence of a browser is very restrictive and leads to unnecessary complexity and a reduction in the functionality offered to the guest. Many of the applications listed above do not have a browser interface.

### 2.1.2 Hotel

The features from the hotel's perspective are as follows.

- Hotels are able to charge for the service on a daily or hourly basis and integrate those charges into the guest's bill via the hotel's Property Management System (PMS) 15.
- Hotels are able to provide a suite of packaged offerings to guests that are based on content sourced from the Internet; for example, Internet radio stations, audio streams, web conferencing
- A firewall 7 is provided to control access to the internal network.

### 2.1.3 System Requirements

The preferred embodiment of the system is capable of supporting laptops running Windows 95/98/ME, Windows NT 4.0, Windows 2000, Linux and MAC OS 7.5+. Alternative embodiments are capable of supporting laptops running a variety of other operating systems.

### 2.1.4 Internet Connection Requirements

The network service supports:

- TV based internet access for hotel guests
- Laptop access to the Internet for business users
- Hotel housekeeping data for content and software management.

A minimum bandwidth of 512kbps can be delivered to each hotel via ADSL, using local service providers.

- In the preferred embodiment; the LCU 3 ensures that the IP address assigned to the laptop 6 is valid within the system
- In alternative embodiments, the LCU 3 or the laptop 6 uses L2TP tunnelling protocol to "wrap" the IP packets sent between the laptop 6 and the firewall 7 inside IP packets sent between the LCU 3 and the firewall 7.

#### 2.1.4.1 Preferred embodiments

In preferred embodiments, the Laptop Connectivity service uses a form of IP address faking or address translation protocol within the LCU to masquerade the attached laptop using the IP address of the LCU. Thus, to the hotel network, the Laptop Connectivity session appears to be initiated and conducted by the LCU. This is a cost-effective and robust solution, which allows "surfing" of the Internet, use of File Transfer Protocol (FTP), e-mail and will support streamed media content from the Internet.

In preferred embodiments, a form of IP address faking is used. This form of IP address faking differs from Network Address Translation (NAT) protocol as discussed below. Network Address Translation (NAT) protocol is used in certain alternative embodiments.

### 2.1.4.2 L2TP tunnelling

The L2TP tunnelling protocol "wraps" the IP packets sent between the laptop and the firewall inside IP packets sent between the LCU and the firewall. The key benefit of this approach is that the IP addresses within the packets generated by the laptop are preserved, which will support VPN services and other applications that require complex IP addressing.

In certain embodiments, an L2TP network server runs on the Head-End Server 2 in order that the tunnelled packets can be "unwrapped" upon leaving the hotel network, prior to entering the Internet.

Preferred embodiments support L2TP protocol, and other tunnelling protocols.

## 2.2 Messages

There are two categories of message that are passed to the guest; information messages and error messages. In preferred embodiments these messages are displayed to a user via a television 5 connected to an LCU.

### 2.2.1 Information Messages

Information Messages convey instructions, advice and information to the guest relating to the use and facilities provided by the Laptop Connectivity service. The following messages relate to the core operation of the service. However, many more messages may be required in order to make the service as easy to use as possible.

- **[IM1] Billing for service;** A series of pages are dynamically generated based on the guest's profile and services/packages the guest has subscribed to; one message should cover the terms and conditions of the service
- **[IM2] The laptop session is now active;** This message gives the guest instructions about what they can and cannot do while their laptop is connected to the LCU, and also gives details of how to terminate the session
- **[IM3] The guest has decided not to proceed with the laptop session;** This message gives the guest help about disconnecting their laptop from the LCU, and gives relevant billing information
- **[IM4] Connection initiation message;** This message informs the user that the Internet connection is in the process of being made

- **[IM6] The guest has terminated the laptop session on the serial port**; This message gives the guest any instructions that are relevant to disconnecting their laptop
- **[IM7] The guest has terminated the laptop session on the Ethernet port**; This message gives the guest any instructions that are relevant to disconnecting their laptop.

### 2.2.2 Error Messages

Error message convey information to the user about any issue relating to the use of the service by the guest. The messages also provide guidance on how to resolve, or seek help in resolving, the problem. The messages halt the operation of the Laptop Connectivity service, and interrupt the operation of any other service the guest is currently accessing.

- **[EM1] No communications between LCU and laptop**; This may have been caused by a faulty cable, bad connections, or the laptop not being plugged into LCU as directed
- **[EM2] Cannot assign an IP address to the laptop**;
- **[EM3] No Internet connection is currently available**; Either the maximum number of concurrent users are connected to the Internet, or the hotel's connection to the Internet is currently not available
- **[EM4] Connection to Gateway Manager has timed out**; The guest has taken too long to select a billing option.

### 2.2.3 HES/LCU API Messages

The following messages are passed between the LCU and HES during the processes of establishing, maintaining and terminating Laptop Connectivity sessions.

| Ref | Message Content | Direction | Parameters |
|---|---|---|---|
| A M1 | Initiate the Laptop Connectivity application on LCU | HES ⇨ LCU | – Serial / Ethernet connection<br>– Timeout (seconds)<br>– Speed (115.2 kbps)<br>– Data bits (8)<br>– Parity bit (No)<br>– Stop bits (1) |

| | | | |
|---|---|---|---|
| A M2 | Error connecting the laptop to the LCU | LCU ⇨ HES | 1 – Can't connect to laptop<br>2 – Can't assign IP address |
| A M3 | Instruction on next action LCU is to perform | HES ⇨ LCU | 0 – Stop processing<br>1 – Establish connection |
| A M4 | Establish connection between LCU and the Internet | LCU ⇨ HES | IP address of laptop |
| A M5 | Terminate connection between LCU and the Internet | LCU ⇨ HES | IP address of laptop |

**2.3 Storyboard**

The flow chart of Figure 4 shows the navigation through the options and messages that the guest will be presented with by the Laptop Connectivity service, when the user selects 'Laptop Connectivity' in the main menu [MM] shown in Figure 4.

- **[PG1] Laptop Connectivity menu**; this page allows the guest to choose from several options:
  - Connect laptop via serial port
  - Connect laptop via Ethernet port
  - Stop the active session on the serial port
  - Stop the active session on the Ethernet port
- **[PG2] Connect laptop via serial port**; this page presents information on the configuration parameters that must be set by the user on the laptop prior to establishing the connection via the serial port. The page instructs the guest to press the OK button once they have connected the cable and re-booted the laptop. The page also gives the guest instructions about what they can and cannot do while their laptop is connected to the LCU, and also gives details of how to terminate the session.
- **[PG3] Connect laptop via Ethernet port**; this page instructs the guest to press the OK button after connecting the cable and re-booting the laptop. The page also gives the guest instructions about what they can and cannot do while their laptop is connected to the LCU, and also gives details of how to terminate the session.
- **[PG4] Stop the active session on the serial port**; this page gives the guest instructions on how to disconnect their laptop from the serial port.

- **[PG5] Stop the active session on the Ethernet port**; this page gives the guest instructions on how to disconnect their laptop from the Ethernet port.

### 2.4 Establishing a Connection

The flow chart of Figure 5 describes the key processes and decision points when establishing a connection between the laptop and the Internet. The LCU ports are passive devices, and do not check whether anything is connected to them. For this reason, the guest starts and stops the session from the main menu [MM] shown in Figure 4.

Figure 5 shows a number of steps which will now be described in the form of an 'Overview of Processes', followed by a description from the point of view of the Gateway Manager, and then a description from the point of view of the Laptop Connectivity application.

#### 2.4.1 Overview of Processes

[301]The guest selects the Laptop Connectivity page [PG1] from the system menu of Figure 4, and chooses to connect their laptop to the LCU using either the RJ-45 Ethernet connector (via the TelePort) or the D9 serial connector.

Depending on the connection mechanism selected, either the Serial Connection page [PG2] or the Ethernet Connection page [PG3] is displayed. Once the guest has set-up the connection as directed by the instructions on the page and connected their laptop to the appropriate port, they will be asked to switch on or re-boot their laptop, and press the OK button to confirm that the laptop has been connected as instructed. When the OK button is pressed on either [PG2] or [PG3], a message will be sent from the HES to the LCU instructing the LCU to start the Laptop Connectivity application. If the LCU cannot communicate with the laptop, an error message is raised. The LCU pings the laptop in order to ascertain whether it can communicate with the laptop, and in order to ascertain the IP address of the laptop.

[302] The Laptop Connectivity application will have to assign a valid IP address to the laptop, by Dynamic Host Configuration Protocol (DHCP) or subnet or virtual local area network (VLAN). If the laptop does not have an IP address, the LCU requests a valid address from the HES and assigns the address to the laptop. If the laptop has its own IP address, the LCU uses IP masquerading to hide the laptop's address behind a valid IP address obtained from the HES. If the LCU cannot establish an IP address for the laptop, an error message is raised.

[303] In preparation for the session, the Laptop Connectivity application sends a message to the Gateway Manager requesting a connection to the Internet. This test is made before running the subscription process to ensure the connection can be satisfied. If the request is rejected, an error message is raised.

[304] The next step is to check whether the guest has already subscribed to the Laptop Connectivity service. If the guest has already subscribed to this service and the subscription period is valid proceed to step [307], otherwise proceed to step [305].

[305] If the guest has not subscribed to the service or the subscription period has expired, then a message is sent to the Billing Manager. The Billing Manager handles the subscription process [IM1].

[306] Once the guest has subscribed to the service, proceed to step [307]. If the guest chooses not to subscribe to the service, proceed to step [310].

[307] The Connection Initiation Message is displayed on the browser informing the user that the connection is in the process of being made. In parallel, the LCU sends a message to the Gateway Manager accepting the reserved Internet connection. If the request for a connection has timed out, an error message is raised

[308] Once the Gateway Manager has sent a response to the Laptop Connectivity application acknowledging that the connection has been set up, proceed to step [309]. If the Gateway Manager cannot establish an Internet connection, an error message is raised.

[309] The session is now active. Message [IM2] is displayed and left on the television until the guest acknowledges the message.

[310] If the guest has not subscribed, then the Gateway Manager removes the reservation for an Internet connection. The Laptop Connectivity application raises an information message [IM3] to remind the user to disconnect their laptop from the LCU.

[311] The Laptop Connectivity application is closed, and the LCU returns to its original state.

### 2.4.2 Gateway Manager

The functions of the Gateway Manager will now be described with reference to Figure 5.

Step [301] – The guest selects the Laptop Connectivity page [PG1] from the system menu, and is given the option of connecting either by Serial or Ethernet cable.

- If a serial connection is required, page [PG2] is displayed and the guest is given details of how to set up their laptop serial port and how to attach the serial cable between the laptop and the LCU. Once connected, the guest presses the OK button on page [PG2] and message [AM1] is sent by the HES to the Laptop Connectivity application.
- If an Ethernet connection is required, page [PG3] is displayed and the guest is given details of how to attach the Ethernet cable between the laptop and the LCU. Once connected, the guest presses the OK button on page [PG3] and message [AM1] is sent by the HES to the Laptop Connectivity application.

When the Gateway Manager receives message [AM4] from the Laptop Connectivity application it starts step [303]. The following outcomes are possible:

- If step [303] fails, the Gateway Manager sends API message [AM3; 0] to the Laptop Connectivity application
- If step [308] determines that no Internet connection is available, then API message [AM3; 0] is sent to the Laptop Connectivity application
- If step [308] establishes an Internet connection, then API message [AM3; 1] is sent to the Laptop Connectivity application.
- After step [310], API message [AM3; 0] is sent to the Laptop Connectivity application

**Step [303]** - When the Gateway Manager receives API message [AM4] it checks the number of active connections it is managing. If the number of connections is at the maximum, the connection request is rejected and API message [AM3; 0] is sent to the Laptop Connectivity application. Error message [EM3] will be raised. If connections are available, the Gateway Manager reserves a connection against the IP address of the subscribing LCU. The Gateway Manager holds the reservation for a timeout period, after which it cancels the reservation.

**Step [304]** – The Gateway Manager makes a request to the Billing Manager to establish whether the guest has already subscribed to this service. If the Billing Manager confirms that the guest has a valid subscription, proceed to step [307]. If the guest does not have a valid subscription, the Billing Manager gives them the opportunity to subscribe to the service; steps [305, 306]. If the guest takes out a valid subscription, proceed to step [307]. However, if the guest chooses not to subscribe to the service, proceed to step [310].

**Step [307]** – The Gateway Manager now checks whether the reserved connection is still available, as the timeout period for holding reservations may have expired. During this process,

information message [IM4] is displayed. If the Gateway Manager determines that no reservation is active, API message [AM3; 0] is sent to the Laptop Connectivity application and error message [EM4] is displayed.

**Step [308]** - The Gateway Manager now attempts to establish an Internet connection. If the connection can be established, API message [AM3; 1] is sent to the Laptop Connectivity application, however, if an Internet connection cannot be established, API message [AM3; 0] is sent to the Laptop Connectivity application and error message [EM3] is raised.

**Step [309]** - The session is now active. Message [IM2] is displayed and left on the television until the guest acknowledges the message. The Gateway Manager sends an Open Session record to the Billing Manager (see description of Figure 8 for more detail on the operation of the Billing Manager).

**Step [310]** – The Gateway Manager deletes the connection that was reserved by the subscribing LCU. The Gateway Manager sends API message [AM3; 0] to the Laptop Connectivity application, and information message [IM3] is raised.

### 2.4.3 Laptop Connectivity Application

The functions of the Laptop Connectivity application will now be described with reference to Figure 5.

The Laptop Connectivity application on the LCU is started on receipt of API message [AM1] from the HES.

**Step [301]** – The Laptop Connectivity application will check that it can communicate with the IP address on the stated port. Attempts to establish communications should continue for as long as specified by the timeout interval defined in message [AM1]. If communication is not possible, API message [AM2; 1] is sent to the Gateway Manager, error message [EM1] is raised, and the application is terminated.

**Step [302]** - If the Laptop Connectivity application was started with no IP address, a dummy IP address must be assigned to the device. If this fails, API message [AM2; 2] is sent to the Gateway Manager, error message [EM2] is raised and the application is terminated.

If both steps [301] and [302] are successful, the Laptop Connectivity application sends API message [AM4] to the Gateway Manager containing the IP address of the LCU.

The Laptop Connectivity application now waits for receipt of API message [AM3] from the Gateway Manager with instructions on what action to perform next. If no message is received within the timeout period, perform step [311]. If the Laptop Connectivity application receives API message [AM3; 0] from the Gateway Manager, a connection to the Internet is not to be established and step [311] is performed. If API message [AM3; 1] is received, a connection to the Internet has been established, and step [309] is performed.

**Step [309]** – Start listening to the traffic being sent by the device on the connected port. The application uses the IP filter hook function within the network stack to substitute the source IP address of each packet received from the attached device with the IP address of the laptop before forwarding the packet to the firewall. Each packet is contained in a virtual local area network (VLAN) so that the guest cannot access any other part of the hotel network.

**Step [311]** – Close down the Laptop Connectivity application.

**2.5 Managing the Session**

The firewall controls and monitors Internet access by guests, and writes usage information to the *syslog* daemon which runs on the HES, and which records all operations and commands. The flow chart of Figure 6 describes the key processes and decision points whilst there is an active session between the laptop and the Internet.

[401] At a regular interval (e.g. every minute) the Firewall transfers the usage statistics it has collected since the last transfer to the syslog running on the HES. This interval is held as a system parameter.

[402] A daemon process on the HES, called the Billing Manager Probe, regularly (e.g. every 5 minutes) reads the syslog and creates an Intermediate Session record. This interval is held as a system parameter.

[403] The Billing Manager Probe sends the Intermediate Session record to the Billing Manager.

[404] The Billing Manager Probe checks the most recent session records to determine whether there has been any activity by the session within the session timeout interval (e.g. 15 minutes). This interval is held as a system parameter.

[405] If there has been no activity in the session timeout interval, the Billing Manager Probe sends API message [AM5] to the Gateway Manager.

### 2.6 Terminating a Connection

The flow chart of Figure 7 describes the key processes and decision points when terminating the connection between the laptop and the Internet.

[501] When the guest wants to finish their Laptop Connectivity session, they select the Laptop Connectivity menu page [PG1] from the system menu [MM] shown in Figure 4, and choose to end either the session on the serial port [PG4] or the session on the Ethernet port [PG5].

[502] The Laptop Connectivity application returns the LCU to its original state.

[503] The Gateway Manager is notified that the Internet connection is no longer required by this session. This step does not require a response from the Gateway Manager.

[504] The Gateway Manager sends a Close Session record to the Billing Manager. The Billing Manager handles the process of informing the guest of any charges that have been incurred during the session, along with the status of any packages that the Laptop Connectivity session is bundled within.

#### 2.6.1 Laptop Connectivity Application

The Laptop Connectivity application performs step [501] and immediately send API message [AM5] to the Gateway Manager. Without waiting for a response from the Gateway Manager, the Laptop Connectivity application initiates step [502].

#### 2.6.2 Gateway Manager

When the Gateway Manager receives API message [AM5] it initiates steps [503-505] and will not send any further messages to the Laptop Connectivity application. The Gateway Manager handles all interactions with the guest via the browser.

### 2.7 Configuration Parameters

In the preferred embodiment, the Laptop Connectivity service requires the following system parameters to be maintained and configured for each installation, in order for the service to operate as described in the preceding sections.

#### 2.7.1 Laptop Connectivity Application

- Timeout period for trying to establish a connection between LCU and laptop
- Serial connection defaults:
  - Line speed; default = 115.2 kbps
  - Data bits; default = 8
  - Parity bit; default = No
  - Stop bits; default = 1

### 2.7.2 Gateway Manager

- The maximum number of users allowed to access the service concurrently
- The timeout period for deciding when to expire reserved connections

### 2.7.3 Billing Manager Probe

- Interval for Firewall to transfer usage statistics to the HES syslog
- Interval for the probe to send usage records to the Billing Manager
- The timeout period for deciding when to expire inactive sessions

These parameters are maintained in the Administration section of the system.

### 2.8 Displaying Messages on the Television

Whenever a message is generated by the Laptop Connectivity service, the LCU 3 issues a command to the HES 2 to display the message page on the television 5. The following actions are taken depending on the active state of the LCU:

- If the television is off, it will have to be switched on and the browser is invoked with the URL of the message page
- If the browser is active, the message page URL is passed to the browser
- If an audio or video stream is being processed, the display of the stream is suspended and the browser is invoked with the URL of the message page
- If a stream from the television aerial is being processed, the browser is invoked with the URL of the message page.

**2.9 Billing**

Billing for the Internet Connectivity service is based on the concept of "Open", "Intermediate" and "Close" session records. A single Open Session record is generated by the Gateway Manager 20 once the session has started, and this is sent to the Billing Manager 22 so that the billing process can be initiated. At regular intervals during the session (every 5 minutes), Intermediate Session records are generated by a process on the HES that monitors session usage; these records are also be sent to the Billing Manager 22. When the session has been completed, the Gateway Manager 20 sends a single Close Session record to the Billing Manager 22.

The Billing Manager uses these records to maintain a profile of session usage by the guest. This profile is dynamically monitored and compared against the package that the guest used to purchase the Laptop Connectivity service. If the package expires, or a threshold is reached, the Billing Manager prompts the guest to extend the existing package or purchase a new package. At the end of the session, or whenever requested by the guest, the Billing Manager provides a cumulative summary of current usage.

The Billing Manager can bill a guest based upon the type or quantity of data sent to a user, or based upon connection time. A package purchased by a guest may provide unlimited Internet access within a fixed period of time, or may provide for charging in proportion to connection time or type or quantity of data transferred, or may provide a unlimited access up to a certain limit, with additional charges for going beyond this limit.

The flow chart of Figure 8 describes the key processes and decision points that relate to billing, while there is an active session between the laptop and the Internet.

[601] Once a session has been started, the Gateway Manager sends an Open Session record to the Billing Manager with details of the LCU that is managing the session.

[602] Information in the Open Session record includes the LCU address, from which the guest details can be derived, and the IP address of the LCU so that subsequent usage statistics gathered from the Firewall can be processed. A session record is created which is used for gathering cumulative usage data for the session.

[603] The process that monitors the syslog on the HES sends an Intermediate Session record to the Billing Manager on a regular basis with session statistics.

[604] Session statistics from the Intermediate Session record are added to the session record created by the Billing Manager. The Billing Manager compares the cumulative usage data for the session against the package that the guest has selected for billing. In the event of a breach of a billing parameter threshold, the Billing Manager enters into a dialog with the guest to either renew the subscription, or to terminate the session.

[605] When the session is terminated, the Gateway Manager sends a Close Session record to the Billing Manager with details of the LCU that is managing the session.

[606] Information in the Close Session record included the LCU address and the IP address of the LCU. Session statistics from the Close Session record are added to the session record created by the Billing Manager. The Billing Manager compares the cumulative usage data for the session against the package that the guest has selected for billing and displays a summary of usage at the end of the session for the guest's information.

The Billing Manager maintains duration, volume, and destination statistics for each session. In one embodiment, only duration based information is processed by the Billing Manager. Alternative embodiments can provide support for volume based billing and billing based on the sites visited.

### 2.10 LCU Operations Available during a Laptop Connectivity Session

While the laptop is connected to the LCU, the guest is able to watch free-to-air television delivered via coaxial cable, delivered for instance via conventional television reception means. Depending on the system resources available within the LCU, the guest may also watch video and audio streams served from the HES or use Internet-on-TV services, and access Internet based services through the browser or access other, non-browser based, Internet services or applications simultaneously.

### 2.11 Gateway Manager

The Gateway Manager 20 is the central point for controlling access to Laptop Connectivity & Internet On TV Services, and monitoring their usage. There are a number of components with which the Gateway Manager communicates, as illustrated in Figure 9.

#### 2.11.1 Gateway Manager Interface

A Gateway Manager Interface 701 exposes the set of operations which can be performed by the system to negotiate the service session. They are implemented in Java as a set of datagram sendable XML messages.

The Gateway Manager instructs the LCU 3 to stop and start the services, periodically it polls for the connections being active.

### 2.11.2 Windows & Citrix Terminal Services

In the preferred embodiment, Internet on TV sessions are hosted by a Windows 2000 server 702 running Citrix Terminal Services.

### 2.12 Setup

Each component requires some amount of configuration to enable Laptop Connectivity & Internet on TV Services to function correctly. Each component's configuration is specific and varies in its degree of complexity.

### 2.12.1 GatewayManager

The GatewayManager is a Java Application installed on the HES, with the system, to manage access to services.

For laptop Connectivity it issues the LCU with its IP addresses for the Laptop IP & IP Faking. The Address is calculated from the IP Address issued to the LCU via DHCP.

### 2.12.2 Citrix Session Manager (KFCitrixSessionMgr)

This is an NT Service, installed on the Windows2000 Citrix Terminal Server, which monitors logged on Citrix sessions and notifies the Gateway Manager when a session closes. The Service can accept a request to logoff a named user session. This will not return the LCU to the main menu, it is a local logoff only.

### 2.12.3 Genbrowse

This is a custom Internet Explorer for Internet on TV. It communicates with the GatewayManager stream socket server using XML to request user & tariff details, notify application exit and subscription timeout. All required parameters are sent by the GatewayManager to the LCU in the request to start the Citrix client.

Genbrowse is installed on the Windows 2000 Citrix terminal server and is available to all users. It may be included on the system path.

### 2.12.4 Windows 2000 Citrix Terminal Server

The Windows 2000 server needs users to be created to accept/host Internet on TV sessions. These users should all be in the same group, with only local and minimal privileges. The users are named from 0 to gateway.maxsessions in the format **userN**. Their passwords are likewise.

The KFCitrixSessionMgr service needs to be installed to monitor the user logons to Citrix. Its parameters are held in the registry;

HKEY_LOCAL_MACHINE/SOFTWARE/Knight Fisk/CitrixSessionMgr.

| | |
|---|---|
| HEShost | Name of host machine running the GatewayManager |
| HESport | IP Port used by the GatewayManager Interface to communicate to the GatewayManager. |
| Port | IP Port used by KFCitrixSessionMgr to accept requests from the GatewayManager |
| TraceExecution | A numeric trace level, default to 5. |
| TraceLogFile | Full path to Log file. |

### 2.12.5 HES

The Syslogd daemon has to be configured to accept remote logging. This is achieved by starting it with the –r switch.

The syslog.conf file requires modification to filter the firewalls messages into a separate file.

### 2.13 System Requirements

The HES comprises an Application Server which, in preferred embodiments is installed with a minimum of Microsoft Windows 2000 Server SP2 (the latest Service Packs should always be applied), Citrix Metaframe XP (XPs for 20-30 users, Xpa for >30 users), Microsoft Internet Explorer 6.

### 2.14 Display of "active laptop session' screen

The display of "active laptop session" screen despite inability to go online is now discussed.

In some embodiments, a post purchase laptop screen informs the user that the session is "active although the user may not actually be online". "Active session" means that the laptop session is enabled by the LCU. If the user's laptop is not correctly configured, he will be unable to access the Internet.

In preferred embodiments, the system identifies whether or not the user is able to surf. This can be based on the allocation of a dynamic IP address to the laptop or the detection of a handshake that proves the user is able to go online.

Depending on the outcome, Success or Failure, the system presents one of two screens: namely that the user is online or is not.

Logically the purchase screen will only be presented, and a charge posted to the PMS 15, once success is established, NOT when the PIN is input.

The laptop connectivity service is responsible for managing a set of available connections. They are managed and allocated centrally, on a first come first served basis. Once a session is allocated the port on the LCU is opened and initialised, it is then the responsibility of the Laptop to negotiate with the LCU to obtain network services. The set-up of the Laptop, and its operating system version, is key to the success of the connection. If the operating system is not supported or the laptop set-up in an incompatible manner the connection will fail.

- The GatewayManager uses the Firewall Syslog to watch for surfing. This can be extended to issue a warning dialog at the end of the first timeout period.

- A Ping to the Laptop can be made to check the network connection is functioning at a lower level correctly. The routes that are added to the firewall have to be added also on the machine hosting the GatewayManager, i.e. the HES. This allows the PING to be routed to and from the Laptop. The converse is that the Laptop can now 'see' the HES. Alternatively, a 'ping relay' is implemented on the LCU. The HES can ask an LCU to ping the laptop on its interface, this remote relayed ping requires no routes to be added on the HES.

- Check the physical connection of the cable. LCU message can be trapped/checked.

Although these extensions can give more information about the connection they can not necessarily indicate whether the Laptop could surf the internet, or collect e-mail from their Internet Service Provider (ISP).

A Help page per operating system would also be helpful to the laptop user.

In a preferred embodiment, the system provides high speed internet access through both a TV and a laptop, in hotels, in one integrated system. Connection is typically 2Mbs. Guests can surf the web or retrieve and send e-mails.

## 2.15 Operation

The operation of the laptop connectivity feature is now discussed in more detail.

The laptop connectivity function enables a guest to connect a PC to the Internet by connecting into the guest Ethernet port of the LCU unit. Traffic is routed through the system network to an external firewall and the Internet beyond.

The guest achieves access to the Internet with a minimum of fuss. The following is assumed:

- The guest laptop has a generally reliable 10BaseT-capable Ethernet interface
- The guest laptop has a generally reliable TCP/IP network stack.
- If the guest laptop has a static IP address defined, it also has a gateway and Domain Name service (DNS) server setting defined.

The LCU offers the following to the laptop:

- A DHCP server issues an IP address, gateway and DNS server to a laptop which has a DHCP client
- IP address faking to a laptop with static IP address. This allows the laptop traffic to pass through the network with a valid routable IP address.
- DNS request redirection to the local DNS server for when the laptop has a fixed setting.
- Acts as a gateway when the laptop expects a gateway to exist.

There are no specific requirements as to the operating system on the laptop – so long as its networking components comply with the relevant RFCs.

### 2.15.1 Initialisation of guest laptop support

The head-end server passes IP addresses for the second interface of the LCU and for the laptop at the time it asks to activate the laptop interface.

Most of the initialisation is actually done when the head-end server calls a start Laptop Connection RJ45 function for the first time.

A function is invoked to attach a TCP/IP stack to the LCU's guest Ethernet port.

The IP address assigned to the laptop is added to the LCU's host table with the fixed name "officialLaptop".

Finally a function, startDhcpServer(), is called to launch a DHCP server on the guest Ethernet port. This server is configured to provide only one address – that which is assigned to the laptop. It is also set up to provide the address of a DNS server (currently the same one offered to the LCU by the head-end server in its own DHCP service) and to set the default gateway of the laptop to be the LCU itself.

It is worth noting that startDhcpServer() also launches a separate task "tDhcpsSPR31821". This is a workaround to Windriver SPR #31821 which caused DHCP requests on the main Ethernet port to tie up Ethernet buffers because that port is not being serviced by the LCU's DHCP server.

The head-end server will have provided an IP address for the LCU's guest Ethernet port, an IP address to assign to the laptop and a netmask which describes the two addresses as being on the same subnet while providing differentiation from the IP address of the main network port.

This degree of setup is sufficient for supporting a laptop with a DHCP client. It broadcasts a request for a DHCP server to the LCU's guest port – the LCU responds with the assigned IP address, DNS server setting and itself as the default gateway. Traffic from the laptop arrives at the LCU which then routes it out its own default gateway provided by the head-end server. Traffic arriving at the LCU for the laptop is routed through to the guest port using normal routing procedures.

**2.16 Example**

The various features in the LCU to allow this to succeed will be introduced by walking through the following example.

When a laptop has a fixed IP address it should also, as stated in the assumptions above, have a setting for the DNS server and the default gateway.

Assuming this, a reasonable first activity by the guest laptop would be to attempt to look up the IP address of a public Internet website given to it by its user via a web browser. Having found out the address the laptop would then try to open communication with the website via its default gateway.

### 2.16.1 Example call to DNS

The laptop wishes to communicate with a DNS server to translate the name of a web service into an IP address. It already knows the IP address of what it thinks is a valid DNS server. We will assume for this example that the address is within the laptop's local network as defined by its own IP address and netmask.

### 2.16.2 Address Resolution Protocol (ARP) request

The first thing to happen is the laptop wants the MAC address of the DNS server, so it makes an ARP request containing the IP address of the DNS server.

The DNS server is not on the network between the laptop and LCU. The LCU has the ability to deal with such requests though, so needs to persuade the laptop to talk to it anyway.

The routine *dev_1/ipaddress/ipFakeLaptop.c* ipFakeLaptop() installs an Ethernet driver hook on the LCU's guest port Ethernet driver. The hook is called laptopEthernetInputHook() and resides in the same file.

The LCU's guest port Ethernet driver sees all ARP requests because they are addressed to the broadcast MAC address ff:ff:ff:ff:ff:ff. The Ethernet frame containing the request is passed to laptopEthernetInputHook(). Once it has established that it is indeed an ARP request, it builds and transmits its own reply which claims that the MAC address for the requested IP address is the same MAC address as the LCU's guest port.

In addition, an entry is made to the laptops[] array which records the IP address and MAC address of the ARP request just answered. This is used later in ipFilterHook() to recall the MAC address not immediately available to that function.

The laptop learns the association of the requested IP address with the MAC address and thereafter will send traffic for that address to the LCU, not knowing it is talking to an "imposter".

Note: it is not possible to do this "fake" ARP through "official" vxworks ARP-related calls because it is not possible to put an entry into the ARP table to say "if any address, respond with this MAC address". The ARP protocol handler provided by vxworks does not come with source code or much external control. It might have been possible to write a new broadcast protocol handler and situate it "before" the ARP protocol handler but the Ethernet hook method is efficient and eliminates the chance of something else in vxworks causing an obstruction.

### 2.16.3 Learning from the first IP packet to travel from laptop to LCU

The laptop now sends out a DNS request in an IP UDP packet, with the IP address set to that it knows for DNS and the MAC address set to the guest port of the LCU. The LCU Ethernet driver receives the packet and passes it into the bottom of the TCP/IP stack.

We know that the IP address of the DNS server can be assumed to make no sense to the LCU. The LCU itself is not a DNS server but it does know the real IP address of one. The next step is to intercept the packet in the stack before it reaches the routing tables which would probably forward it to the LCU's default gateway and basically lose it.

The routine *dev_1/ipaddress/ipFakeLaptop.c* ipFakeLaptop() installs a hook to examine IP packets before they are routed. This uses an "official" vxworks method using the ipFilterLib library. The call is made to ipFilterHookAdd() and the hook function registered is ipFilterHook().

Briefly, ipFilterHook() and subsidiary functions have a number of responsibilities:

- Replace the static IP address of guest laptop traffic with the assigned laptop address recognised by the rest of the network.
- Replace the assigned laptop address of returning guest laptop traffic with the genuine static IP address of the laptop.
- Learn the static IP address of the guest laptop and use it to replace the assigned network address in returning traffic.
- Modify the checksums of UDP or TCP packets which have had their addresses changed, to avoid the receiver believing them corrupt.

In the case of the first DNS UDP packet to come into ipFilterHook(), the function takes the opportunity to learn the IP address of the laptop before redirecting the packet to the real DNS server.

The arguments passed by vxworks to ipFilterHook() describe the interface on which the packet arrived. In this case it will have arrived on eth1 – the LCU's guest port.

As the source IP address (the genuine static laptop address) does not match the assigned address the function realises that it needs to learn it.

The first thing to do is set up an entry in the ARP table for the assigned laptop address, giving it the MAC address of the real laptop. The MAC address is not available in the IP packet passed to ipFilterHook() so the code looks in the laptops[] array for a match on the IP address. An entry should be present, and the information used to add the entry to the ARP table. This entry is used later on when routing traffic containing the genuine static laptop IP address back to the laptop.

An entry is added to the hosts table with the fixed name "fakeLaptop" and the genuine static laptop IP address. This is a useful debug aid and also prevents the DNS resolver on board the LCU from ever attempting to find a name for the laptop from the real DNS server – a fruitless task which would most likely cause an unpleasant delay.

A call is then made to mRouteAdd to create a host route for the genuine static laptop IP address using the assigned IP address as a gateway. Again this is used later on when routing traffic containing the genuine static laptop IP address back to the laptop.

The current idea of the current DNS server (unlikely to change without a reboot in practice) is updated. This completes the "learning" phase of ipFilterHook().

Finally, with the learning all done, the "normal" processing of the packet from the laptop can take place. changeSrcAddress() is called.

### 2.16.4 Faking the source address

changeSrcAddress() is passed the assigned IP address for the laptop. It checks the type of data in the IP packet – currently TCP and UDP types are supported, ICMP is supported just enough to make ping work.

In the case of the laptop's DNS request, the type is UDP. This case has an extra check of the value of the IP port for which the packet is aimed. If it is port 53 then this is recognised as a DNS request. This triggers a unique behaviour – as the code knows the address of a local DNS server the destination IP address in the packet is changed to that of the local DNS server and the UDP checksum corrected. The normal behaviour of changing the source address from that of the laptop to the assigned address and correcting the checksum follows on.

Having done this, the hook then passes the packet back to the stack where it is routed based on its new addresses. It is sent out onto the main network to the DNS server who should accept it and in the normal running of things, find an answer. This answer now needs to find its way back to the laptop.

### 2.16.5 Proxy ARPing the laptop

As explained above, the LCU's guest port and the laptop itself are on a different subnet from the main network. This means that a server on the main network cannot talk directly to the guest laptop. This means that the LCU hosting the guest laptop has to be a gateway to it, which in turn means that each server would need to know which assigned laptop was "behind" which LCU, and route the traffic to that LCU.

This solution is workable on a simple network and has some security advantages. However, it turns out to be practically impossible on a real-world network where multiple layers of switches lie between servers and the LCU.

The solution is for the LCU to proxy-ARP for the laptop address. This works in much the same way as when the LCU pretends to be any host for the laptop, except that in this case the LCU will only for the laptop address.

*dev_1/ipaddress/ipFakeLaptop.c* ipFakeLaptop() installs an Ethernet driver hook on the LCU's main network port Ethernet driver. The hook is called mainEthernetInputHook() and resides in the same file.

This sees all ARP requests broadcast on the main network but only responds to those requesting its own assigned network address.

The DNS server therefore broadcasts an ARP request for the assigned laptop IP address and receives the LCU's main network port MAC address in response.

It had been hoped that this proxy-ARP arrangement could be done through official vxworks functions rather than through the Ethernet driver hook, which on the main network port is rather busy, especially if MPEG-2 is streaming through. However, the presence of multiple Ethernet interfaces on the LCU does not seem to be anticipated well in vxworks. In addition the DHCP server task removes the "special" entries placed into the ARP table for the purpose and replaces them with its own run-of-the-mill entries which are of no use for present purposes. Therefore an Ethernet driver hook is used, coded as efficiently as possible. It does not have a significant detrimental impact on performance.

### 2.16.6 Returning packets to the laptop

The DNS server knows a MAC address to send its DNS response to and so it does so. This is received by the LCU and arrives in ipFilterHook(), this time from Ethernet interface eth0. The packet carries the assigned laptop IP address so it has it put back to the genuine static laptop address using changeDstAddress(). Again this function supports TCP, UDP and enough ICMP to support ping.

Having made this change the packet is passed back to the stack and reaches the routing tables. Earlier, a host route was set up so that all packets for the genuine static IP address would be routed via the gateway that was specified as the assigned IP address. This route is followed, which causes the correct interface (eth1) to be identified for the output. The packet needs a MAC address for transmission and in this case wants the MAC address of the gateway – the assigned IP address. Also above, an entry was made into the ARP table associating the assigned IP address with the laptop's own MAC address. This is picked up as the MAC address of the "gateway". So the packet transmitted has the correct IP address and by juggling the use of the concept of a gateway, also has the correct MAC address for the laptop. The laptop happily receives the packet and has the DNS response to give it the IP address for the web server.

### 2.16.7 Example subsequent call to web server

Following the successful DNS call above the guest laptop would send out a TCP packet to the web server's IP address. Since this will not be on what the laptop thinks is its local subnet, it will send it via its default gateway.

The guest laptop will send an ARP request for the default gateway's IP address. As above, the LCU will send out a fake response to indicate that the gateway has the LCU's MAC address. The laptop will direct its TCP traffic at the given MAC address; the LCU will receive it in its network stack. The ipFilterHook() hook will be called for the packet. Since the LCU is already familiar with the source IP address it does not need to "learn" about it, so changeSrcAddress() is called for the packet to give it the assigned source address. The packet is returned to the stack and routed to the web server normally.

The return traffic from the web server is treated exactly as the response to DNS described above.

### 2.16.8 Updating IP packet checksums

The functions changeSrcAddress() and changeDstAddress() change the source or destination address in the packet for a different address. The address itself appears in the IP packet header. Changing it has different consequences depending on what is in the packet.

### 2.16.9 ICMP packet (for ping)

The facility to change the packet is provided as a debug aid. ICMP does not include any checksum based on the content of the IP header so just changing the address is sufficient to fake the ping.

### 2.16.10 TCP Packet

A TCP packet does contain a checksum that takes the addresses in the IP header into account. Fortunately the TCP checksum is basically a simple sum of data so adjusting it without having to recalculate the whole thing is possible by subtracting the values of the old address and adding in the values of the new one.

### 2.16.11 UDP packet

A UDP packet does contain a checksum that takes the addresses in the IP header into account. This checksum can be zero, in which case the sender is indicating that they are not interested in supporting the checksum. If the checksum is zero then it must be left at zero. If non-zero then it must be updated in the same fashion as for a TCP checksum.

Note that if a TCP or UDP packet carries an IP address within application level data then the faking will not be successful. Although the traffic will be routed correctly the application at the remote end not be able to make sense of the genuine static laptop address at the higher level.

## 2.17 Differences between the LCU IP faking and Network Address Translation

On the surface it may seem that what the LCU laptop address faking does, in the preferred embodiment, is similar to the established practice of Network Address Translation (NAT). However there are some notable differences:

- NAT expects to know the network address of the private network. As the static IP address of the laptop is not known in advance, the setup for NAT would also not be predictable in advance
- NAT would expect the laptop to know that the LCU is the default gateway and would not provide the ARP faking capability to cause the LCU to receive all laptop traffic
- NAT is aimed at allowing multiple machines on a known private network access the Internet through one official Internet IP address, rather than allowing one machine on an unknown private network access the Internet.

NAT could be adapted to do the job, although at greater expense.

The single significant advantage of NAT is that much work has been done by the Internet community and commercial organisations alike to support changing IP addresses in application data as well as in the IP header. However, the main use of a hotel guest would be browsing the Internet with a web server. No problems are apparent with popular applications, including Virtual Private Network software of interest to business users.

It is possible to enhance the LCU code to address particular application requirements if needed.

## 2.18 Real Time Operating System (RTOS)

Off-the-shelf software products may be used in the LCU, including a real-time operating system (RTOS), such as RTOS Red Hat Linux and system software bundled with Red Hat Linux. The chosen RTOS should provide support for the chosen chip-set and the ability to control streaming video. Any chosen RTOS should also support a TCP/IP stack and drivers for the network interface circuit. The RTOS controlling the LCU may also provide several auxiliary services, such as:

- Proxy IP Server; to map the IP address of the laptop connected to the LCU to the IP address of the LCU
- DHCP Client; for dynamic allocation of an IP address to the LCU
- SNMP Client; to send SNMP traps containing diagnostic information to the server
- Network File System (NFS) Client; to allow the LCU to connect to a network file system through the HES
- Digital to Analogue Converter; a service to manage the decompression of an MPEG2 stream from the HES and its transposition to an analogue stream that will be routed to the television.

**3 Interleaved Content**

Aspects of the system relating to the interleaving of content are now described, in particular, the interleaving of different types of content in transmissions between a HES and an LCU. Various capabilities of the system which derive from the interleaving of content are discussed in more detail, particularly the interleaving of Internet and audio/visual data, and the impression given to a user that at least one apparently continuous stream of data can be delivered in real time simultaneously with the delivery of other data. The interleaving of more than two sets of data and the selective control of one or more interleaved sets of data upon command of a user are also discussed.

A variety of data is transmitted between the HES and an LCU, in particular audio/visual data, particularly digital television/video signals, text data, still images, moving images, EPGs, games, computer data particularly computer programmes or internet data. In preferred embodiments sets of such data are divided into portions and portions of one set of data are interleaved with portions of another set of data.

The first set of data may be a particular piece of content, for instance a film, and the second set of data may be another piece of content, for instance another film.

The portions of the first data set and the portions of the second data set are usually interleaved temporally within a data stream. Typically, each portion of the first data set is transmitted in a respective one of a first set of packets, and each portion of the second data set is transmitted in a respective one of a second set of packets, the packets usually being IP packets.

Upon receipt at an LCU, the portions of the first set of data are processed to form the first set of data, and the portions of the second set of data are processed to form the second set of data.

The portions of the first set of data and the portions of the second set of data can also be retransmitted to an output device without first being recombined. For instance, in one example, the first set of data is audio/visual data in MPEG format, representing a film, and each packet containing a portion of the first set of data is received by the LCU and then streamed to a television connected to the LCU in real time. The second set of data is internet data, and each packet containing a portion of the second set of data is received at the LCU, and streamed to a computer connected to the LCU.

If the size and contents of the interleaved packets of data are chosen appropriately, by an application at the HES, the impression can be given to the user that at least one continuous stream of data is being received, when in fact two interleaved sets of data are being received.

The LCU, either upon command of a user or automatically is able to control independently the transmission of any of the interleaved sets of data transmitted from the HES to the LCU.

The interleaving of content is particularly advantageous when an LCU is connected to more than one device, as it enables content to be transmitted to, and for the HES to communicate with each device, via the LCU, simultaneously.

An example of the interleaving of content is given in Figure 10.

A first video asset (VID1) is transmitted to the HES 2 over the satellite link 52,54,56 shown in Figure 1 and stored by the HES 2.

A second video asset (VID2) is subsequently transmitted to the HES 2 over the satellite link and stored by the HES 2.

LCU 3 requests that VID1 be played in real time on television set 5, and that VID2 be simultaneously played in real time on laptop 6.

The Media Manager divides VID1 and VID2 into N respective packets of data VID1(1), VID1(2)...VID1(N); and VID2(1), VID2(2)...VID2(N). The N packets of data are then transmitted in interleaved form VID1(1), VID2(1), VID1(2), VID2(2) etc. Each packet is then received by LCU 3 and directed to either television 5 or laptop 6 as appropriate.

Figure 11 illustrates the simultaneous output of four videos VID1, VID2 (from TV 5 and Laptop 6 as described above) and VID3 and VID4 (from TV 5' and Laptop 6' attached to a different LCU).

VID1 and VID2 are transmitted in interleaved form to a first LCU (designated in Figure 11 by the label "CHANNEL 1"), and VID3 and VID4 are transmitted in interleaved form to a second LCU (designated in Figure 11 by the label "CHANNEL 2").

Preferably each packet of data VID1(1), VID2(1), VID3(1), VID4(1) etc is an IP packet containing an IP address of the correct LCU. Alternatively the signals may be frequency multiplexed and each LCU would have its own dedicated frequency channel.

Although in the example given above, VID1-VID4 are previously received and stored by the HES 2, it will be understood that one or more of the video assets may be received and immediately forwarded (interleaved with another video asset) to an LCU, without an intermediate storage step.

In an alternative embodiment, audio/video signals (for instance VID1(1), VID2(2)...VID1(N)) may be interleaved with internet signals, enabling a user to surf the internet using laptop 6 whilst watching a movie on television 5.

In a further embodiment the HES may send an information or error message to the user (for instance, the user may have reached some time limit related to billing) and the transmission of audio/visual data and/or internet signals is interrupted whilst the message is displayed on the television 5 or laptop 6. Upon response of the user to the message, (for instance by sending a signal to the LCU using the remote control unit, in response to which the LCU sends a message to the HES), interruption period is terminated and the transmission of the audio/visual data and/or internet signals is resumed. In a variant of this embodiment, the audio/visual data and internet signals continue to be transmitted along with the message data (ie interleaving of three sets of data), and the audio/visual data and/or internet signals are buffered whilst the message data is displayed.

Although the video assets VID1, VID2 in Figure 10 are received and retransmitted by the LCU in real-time, it will be understood that different types of interleaved content may be processed, stored or routed in different ways. For instance some packets of data may be combined at the LCU before storage or retransmission to a connected device.

Certain capabilities of preferred embodiments are now described.

**4. Capabilities of system**

Some capabilities of the laptop connectivity aspects of the system are now described:-

- the system offers TV and laptop internet access at high speed.
- it runs on hotels' existing cabling. It is easy to install. Hotels do not need to rewire or upgrade their networks.
- it offers excellent internet choice. For the first time guests have the choice of accessing the internet through the TV or laptop, both high speed.
- it is easy to install as it run through a hotel's existing cabling. There is no need to rewire or upgrade networks.
- guests have the choice of accessing the internet through the TV or laptop, both at high speed.
- no set-top box is required for TV internet access.
- the system is based on modular technology, which can be easily updated. As such, it is a fully integrated future-proof system. All upgrades take place in the hotel basement with no disruption to guests.
- guests' internet usage is monitored and bandwidth adjusted accordingly.
- a unique 'plug and play' desk port is provided to connect guests' laptops, which has been specially designed for hotels. It is the only piece of equipment needed.
- a simple multi-lingual on-screen guide explains how to use the service. Guests can contact a call centre if they need assistance. There is no need to disturb staff.

Many of the embodiments as described herein (in any aspect or embodiment) are directed to systems within hotels and their installation and use. However, the embodiments, and the systems, methods and features, described herein are also readily installed and used within other environments, in particular multi-user or multi-room environments. Such environments include, in particular:-

Ships, particularly cruise ships
Aeroplanes
Trains
Hospitals
Multi-dwelling units, for instance blocks of flats, or condominiums
Groups of houses

Offices or groups of offices, factories, shops or groups of shops, schools and other work, commercial or educational environments
Stations, airports and other transport termini

Indeed, one of the features of the preferred embodiments is that they are readily transferable between various environments, such as those described above, with little or no modification.

Accordingly, references to a guest shall be taken to include any user of any such embodiment in any such environment.

A feature of the preferred embodiments is that the signals, data or information which are distributed are not limited to audio/visual, particularly television, signals, data or information are preferred embodiments limited to providing entertainment services. Indeed preferred embodiments provide general information, messaging services, alarm calls, pricing and booking information, educational material, documents in electronic format, or indeed any type of material which can be stored or transmitted electronically and retrieved or received by a local server.

In particular embodiments, within hospitals, the system is used to provide messaging, alarm calls, and scheduling information to nurses, doctors and other hospital staff. In some such embodiments, local control units, or in the alternative local servers, are linked to pagers carried by staff.

In particular embodiments within schools, colleges, universities and other educational environments, the system is used to provide educational material, such as lecture notes, textbook material, and audio/visual material, and to enable communication between teachers and students, as well as providing general messaging, timetable and information services.

In particular embodiments within groups of houses, the system is used to provide entertainment, such as terrestrial and satellite television, radio, audio, video on demand, scheduled films, and games, educational material such as textbook material, lessons, lecture notes, and audio/visual material, advertising, both general and targeted, banking and other financial services, shopping services, and general information.

In particular embodiments within hotels, ships, trains, aeroplanes, stations, and airports, the system is used to provide, in addition to some of the material and services described above, timetable, ticketing, reservation, weather and other travel related information.

In particular embodiments within offices, factories and other work environments, the system us used to provide, in addition to some of the material and services described above, access to documents in electronic form, recordal of employee attendance, diary and scheduling services, payroll information and services, training material, and logistical information.

The following is applicable to any aspect or embodiment as described herein, or as illustrated in the accompanying drawings.

Features which relate to the storage of information may be implemented by suitable memory locations or stores. Features which relate to the processing of information may be implemented by a suitable processor or control means, either in software or in hardware or in a combination of the two.

Analogous method steps to any of the apparatus features described anywhere herein are provided within the scope of the invention, and vice versa. In any or all of the aforementioned, different features and aspects described above, including method and apparatus features and aspects, may be combined in any appropriate fashion.

The Applicant asserts design right and/or copyright in the accompanying drawings.

It will be understood that the present invention(s) has been described above purely by way of example, and modifications of detail can be made within the scope of the invention.

Each feature disclosed in the description, and (where appropriate) the claims and drawings may be provided independently or in any appropriate combination.

## Claims

1. A system for distributing data, comprising mediating means being adapted for connection to a processor and to mediate communication between a server and the processor.

2. A system according to claim 1 further comprising a server for communicating with the processor via the mediating means.

3. A system according to claim 2 wherein the server is configured to distribute a first set of data and a second set of data to the mediating means by distributing portions of the first set of data interleaved with portions of the second set of data.

4. A system according to claim 3 wherein the mediating means is configured to retransmit the portions of the first set data to a first output device and to retransmit the portions of the second set of data to a second output device.

5. A system according to any of the preceding claims further comprising a network for transmitting signals between the server and the mediating means.

6. A system according to any of the preceding claims, wherein the mediating means is adapted to be responsive to a signal that is transmitted by the server over a network and addressed to the mediating means or to the processor, so that point-to-point communication is established between the server and the mediating means.

7. A system according to claim 6, wherein the mediating means is further adapted to establish point-to-point communication between the server and the processor.

8. A system according to any of the preceding claims, for distributing data to different locations in a local network, preferably for distributing data to different rooms or suites within a hotel, or different dwellings in a neighbourhood, or in hospitality environments such as cruise ships, or office or work environments.

9. A system according to any of the preceding claims, wherein the mediating means comprises control means for controlling operation of the processor.

10. A system according to any of the preceding claims, wherein the mediating means comprises means for assigning an address to the processor.

11. A system according to claim 10 wherein the means for assigning an address to the processor is configured to assign the address dynamically.

12. A system according to claim 10 or 11 wherein the means for assigning an address comprises a DHCP client.

13. A system according to any of the preceding claims, wherein the mediating means is adapted to mediate communication between the server and a further device.

14. A system according to any of the preceding claims, further comprising monitoring means for monitoring communication between the server and the processor and/or the mediating means.

15. A system according to claim 14, wherein the monitoring means is adapted to monitor the quantity of data transmitted between the server and the processor or mediating means and/or the duration of the connection between the server and the processor or mediating means.

16. A system according to claim 14 or 15, wherein the monitoring means is adapted to monitor communication between the server and the processor and or the mediating means at regular intervals.

17. A system according to claim 14, 15 or 16 further comprising a billing manager for receiving monitoring information from the monitoring means, comparing the monitoring information with a stored billing parameter, and outputting a user message to the mediating means if the monitoring information breaches the stored billing parameter.

18. A system according to claim 14, 15 or 16 further comprising a billing manager for receiving monitoring information from the monitoring means, and maintaining a cumulative record of usage based on the received monitoring information, the cumulative record of usage including a user identifier which associates the record with a particular user.

19. A system according to any of the preceding claims, further comprising means for providing a display signal for displaying information concerning communication between the server and the processor.

20. A system according to claim 19 wherein the display signal is for displaying information obtained from the monitoring means.

21. A system according to any of claims 2 to 20, wherein the server is adapted to distribute audio/visual signals, and the mediating means is adapted to receive the audio/visual signals.

22. A system according to claim 21, wherein the mediating means is adapted to receive the audio/visual signals and to mediate communication between the server and the processor simultaneously.

23. A system according to claim 19, wherein the means for providing a display signal is adapted to provide audio/visual signals received by the mediating means according to claim 21 or 22.

24. A system according to claim 22 or any of claims 3 to 23 when dependent on claim 2, wherein the server is adapted to transmit data in response to a request for data.

25. A system according to claim 24, wherein the request for data is received from the processor or mediating means.

26. A system according to claim 24 or 25, wherein the request for data is generated on command of a user.

27. A system according to claim 24, 25 or 26, wherein the server comprises control means adapted to compare the request with control criteria and to distribute data in dependence upon that comparison.

28. A system according to any of the preceding claims, wherein the server is adapted to receive data and to distribute the data, preferably to the mediating means or to the processor.

29. A system according to any of the preceding claims, wherein the server and mediating means are configured to support communication between the server and processor according to a network address translation (NAT) protocol.

30. A system according to any of the preceding claims, wherein the server and mediating means are configured to support communication between the server and processor according to a tunnelling protocol.

31. A system according to claim 30 wherein the tunnelling protocol comprises the L2TP tunnelling protocol.

32. A system according to any of the preceding claims, further comprising means for receiving a connection request from the processor, comparing the connection request with conditional access criteria, and connecting the processor with the server or an external network interface if the connection request complies with the conditional access criteria.

33. A system according to any of the preceding claims, further comprising an external network interface for connecting the server and/or processor with an external network.

34. A system according to claim 33 further comprising a session manager for initiating and terminating a communication session between the processor and the external network interface.

35. A system according to claim 34 as dependent preferably on any of claims 14 to 18, wherein the session manager is configured to notify the monitoring means at the beginning and/or end of the communication session.

36. A system according to claim 34 or 35, wherein the session manager is configured to terminate the communication session if there is no communication between the processor and the external network interface for a predetermined time period.

37. A system according to any of claims 34 to 36, wherein the session manager is configured to receive a connection request from the processor, determine whether a connection with the external network interface is available, initiate a communication session if a connection is available, and output a message if a connection is not available.

38. A system according to any of the preceding claims, further comprising a display for displaying messages to a user, or means for generating a display signal for displaying said messages.

39. A system according to claim 38 wherein the mediating means is configured to cause a display to display messages when the mediating means is not connected to the processor.

40. A system according to claim 39 wherein the mediating means is configured to cause a display to display connection messages which indicate one or more steps to be taken by a user to connect the processor to the mediating means.

41. A system according to claim 39 or 40, wherein the mediating means is configured to cause a display to display disconnection messages which indicate one or more steps to be taken by a user to disconnect the processor from the mediating means.

42. A system according to any of the preceding claims, wherein the mediating means comprises a real-time operating system for controlling streaming video.

43. A system according to any of the preceding claims, further comprising means for intercepting messages, and performing address translation on the intercepted messages.

44. A system according to claim 43, wherein the mediating means is configured to intercept messages between the processor and the server, and to perform address translation on the intercepted messages.

45. A system according to claim 44, further comprising one or more additional mediating means, each configured to intercept messages between a respective processor and the server, and to perform address translation on the intercepted messages.

46. A system according to claim 43 as dependent on claim 2, wherein the server is configured to intercept messages between the processor and an external network, and to perform address translation on the intercepted messages.

47. A system according to claim 46 wherein the server is configured to map an address of the processor to another address by Network Address Translation (NAT).

48. A system according to any of claims 43 to 47, wherein the address translation comprises IP address translation.

49. A system according to any of the preceding claims, wherein the mediating means comprises a real-time operating system including a proxy IP server for mapping an IP address of the processor to an IP address of the mediating means.

50. A system according to any of the preceding claims, wherein the mediating means comprises a real-time operating system including a DHCP client for dynamic allocation of an IP address to the mediating means.

51. A system according to any of the preceding claims, wherein the mediating means comprises a real-time operating system including an NFS client to allow the mediating means to connect to a network file system through the server.

52. A system according to any of the preceding claims, wherein the mediating means comprises a real-time operating system including an analogue to digital converter for receiving a digital stream from the server, converting the digital stream to an analogue stream, and routing the analogue stream to an analogue output device.

53. A system according to claim 52, wherein the analogue output device is a television.

54. A system according to any of the preceding claims wherein the mediating means is adapted to mediate communication between the processor and the server via a Virtual Local Area Network (VLAN).

55. A mediating means adapted to mediate communication between a server and a processor.

56. A mediating means according to claim 55 configured to intercept messages between the processor and the server, and to perform address translation on the intercepted messages.

57. A mediating means according to claim 56 wherein the address translation comprises IP address translation.

58. A mediating means according to any of claims 55 to 57, wherein the mediating means is adapted to be responsive to a signal that is transmitted by the server over a network and addressed to the mediating means or to the processor, so that point-to-point communication is established between the server and the mediating means.

59. A mediating means according to any of claims 55 to 58, further adapted to establish point-to-point communication between the server and the processor.

60. A mediating means according to any of claims 55 to 59, further comprising control means for controlling operation of the processor.

61. A mediating means according to any of claims 55 to 60, further comprising means for assigning an address to the processor.

62. A mediating means according to claim 61 wherein the means for assigning an address to the processor is configured to assign the address dynamically.

63. A mediating means according to claim 61 or 62 wherein the means for assigning an address comprises a DHCP client.

64. A mediating means according to any of claims 55 to 63, further adapted to mediate communication between the server and a further device.

65. A mediating means according to any of claims 55 to 64, further comprising monitoring means for monitoring communication with the server and/or the processor and/or between the server and the processor.

66. A mediating means, according to Claim 65, wherein the monitoring means is adapted to monitor the quantity of data transmitted between the server and the processor or mediating means and/or the duration of the connection between the server and the processor or mediating means.

67. A mediating means according to claim 65 or 66, wherein the monitoring means is adapted to monitor communication with the server and/or the processor and/or between the server and the processor at regular intervals.

68. A mediating means according to any of claims 55 to 67, further comprising means for providing a display signal for displaying information concerning communication between the server and the processor, and preferably for displaying information obtained from the monitoring means.

69. A mediating means according to any of claims 55 to 68, further adapted to receive audio/visual signals.

70. A mediating means according to claim 69, further adapted to receive audio/visual signals and to mediate communication between the server and the processor simultaneously.

71. A mediating means according to 69 or 70, further adapted to display the audio/visual signals on a display means.

72. A mediating means according to claim 71 further adapted to display information relating to communication between the server and the processor on the display means.

73. A mediating means according to any of claims 55 to 72, further adapted to transmit a request for data to the server.

74. A mediating means according to claim 73, wherein the request for data is transmitted in dependence upon a request for data received from the processor.

75. A mediating means according to any of claims 55 to 74, further comprising monitoring means for monitoring communication with or between the server and the processor.

76. A mediating means according to any of claims 55 to 75 configured to support communication between the server and processor according to a network address translation (NAT) protocol.

77. A mediating means according to any of claims 55 to 75 configured to support communication between the server and processor according to a tunnelling protocol.

78. A mediating means according to claim 77 wherein the tunnelling protocol comprises the L2TP tunnelling protocol.

79. A mediating means according to any of claims 55 to 78 configured to receive a connection request from the processor, to compare the connection request with conditional access criteria, and to connect the processor with the server or an external network interface if the connection request complies with the conditional access criteria.

80. A mediating means according to any of claims 55 to 79, wherein the mediating means is adapted for connection to a display, and to cause the display to display messages when the mediating means is not connected to the processor.

81. A mediating means according to claim 80, wherein the mediating means is configured to cause the display to display connection messages which indicate one or more steps to be taken by a user to connect the processor to the mediating means.

82. A mediating means according to claim 80 or 81 wherein the mediating means is configured to cause the display to display disconnection messages which indicate one or more steps to be taken by a user to disconnect the processor from the mediating means.

83. A mediating means according to any of claims 55 to 82, wherein the mediating means comprises a real-time operating system for controlling streaming video.

84. A mediating means according to any of claims 55 to 83, wherein the mediating means comprises a real-time operating system including a proxy IP server for mapping an IP address of the processor to an IP address of the mediating means.

85. A mediating means according to any of claims 55 to 84, wherein the mediating means comprises a real-time operating system including a DHCP client for dynamic allocation of an IP address to the mediating means.

86. A mediating means according to any of claims 55 to 85, wherein the mediating means comprises a real-time operating system including an NFS client to allow the mediating means to connect to a network file system through the server.

87. A mediating means according to any of claims 55 to 86, wherein the mediating means comprises a real-time operating system including an analogue to digital converter for receiving a digital stream from the server, converting the digital stream to an analogue stream, and routing the analogue stream to an analogue output device.

88. A mediating means according to claim 87, wherein the analogue output device is a television.

89. A mediating means adapted for connection to a processor and to a server and to change the address of a message transmitted between the server and the processor, such that the message appears to originate from the mediating means.

90. A mediating means adapted for connection to a processor and to a server and to change the address of a message transmitted from the processor to the mediating means in order to direct it to the server.

91. A mediating means according to claim 89 or 90, further adapted to send a request to the processor to ascertain its address, and to change the address of any message originating from that address.

92. A method of managing communication between a processor and a server, the method comprising mediating communication between the server and the processor with a system or

mediating means according to any of the preceding claims.

93. A network comprising a plurality of systems according to any of claims 1 to 54; and a central hub for transmitting data to the systems.

94. A method of distributing a first set of data and a second set of data, comprising distributing portions of the first set of data interleaved with portions of the second set of data.

95. A method according to claim 94 wherein the first and second sets of data are both distributed to the same device.

96. A method according to claim 94 or 95 wherein the portions of the first set of data and the portions of the second set of data each contain an address identifying the device.

97. A method according to any of claims 94 to 96, further comprising receiving and storing the first and second sets of data prior to distribution.

98. A method according to claim 94 further comprising dividing the stored data sets into respective portions.

99. A method according to any of claims 94 to 98 further comprising labelling the portions of the first set of data; and labelling the portions of the second set of data.

100. A method according to any of claims 94 to 99 further comprising interrupting distribution of the first set of data during an interruption period; distributing portions of a third first set of data interleaved with portions of the second set of data during the interruption period; and resuming distribution of the first set of data at the end of the interruption period.

101. A method according to claim 100 further wherein distribution of the first set of data is resumed in response to user input.

102. A method according to any of claims 94 to 101 further comprising receiving the portions of the first set of data and retransmitting the portions of the first set of data to a first output device; and receiving the portions of the second set of data and retransmitting the portions of the second set of data to a second output device.

103. A method according to any of claims 94 to 102 further comprising receiving the portions of the first set of data and streaming the portions of the first set of data in real time to a first output device.

104. A method according to claim 103 further comprising receiving the portions of the second set of data and streaming the portions of the second set of data in real time to a second output device.

105. A method according to any of claims 94 to 104 further comprising outputting portions of the first set of data from a first output device, and simultaneously outputting portions of the second set of data from a second output device, so as to give the impression to a user that the portions of the first set of data and the portions of the second set of data are received simultaneously.

106. A method according to any of claims 94 to 104 further comprising receiving and outputting a first portion of the first set of data on an output device, and subsequently receiving and outputting a second portion of the first set of data on the output device, such that there is a continuous output of the first set of data on the output device.

107. A method of distributing data to a plurality of control units, the method comprising distributing a first set of data and a second set of data to a first one of the control units by a method according to any of claims 91 to 103; and distributing a third set of data and a fourth set of data to a second one of the control units by a method according to any of claims 94 to 106.

108. A method of distributing data comprising transmitting first and second sets of data from a central hub to a plurality of local servers; storing the first and second sets of data at each local server; and distributing the first and second sets of data from at least one of the local servers by a method according to any of claims 94 to 105.

109. A method according to any of claims 94 to 107, wherein the first set of data is internet data.

110. A server configured to distribute data by a method according to any of claims 94 to 108.

111. A system configured to distribute data by a method according to any of claims 94 to 108, the system comprising a server for distributing the data, and one or more units for receiving and processing the data.

112. A system configured to distribute data by a method according to claim 108, the system comprising a central hub; a plurality of local servers for storing and distributing the data; and one or more units for receiving and processing the data.

113. Apparatus for distributing a first set of data and a second set of data, comprising means for distributing portions of the first set of data interleaved with portions of the second set of data.

114. Apparatus according to claim 113 wherein the first and second sets of data are both adapted to be distributed to the same device.

115. Apparatus according to claim 113 or 114 wherein the portions of the first set of data and the portions of the second set of data each contain an address identifying the device.

116. Apparatus according to any of claims 113 to 115, further comprising means for receiving and storing the first and second sets of data prior to distribution.

117. Apparatus according to claim 116 further comprising means for dividing the stored data sets into respective portions.

118. Apparatus according to any of claims 113 to 117 further comprising means for labelling the portions of the first set of data; and labelling the portions of the second set of data.

119. Apparatus according to any of claims 113 to 118 further comprising means for interrupting distribution of the first set of data during an interruption period; distributing portions of a third first set of data interleaved with portions of the second set of data during the interruption period; and resuming distribution of the first set of data at the end of the interruption period.

120. Apparatus according to claim 119 further wherein distribution of the first set of data is adapted to be resumed in response to user input.

121. Apparatus according to any of claims 113 to 120 further comprising means for receiving the portions of the first set of data and retransmitting the portions of the first set of data to a first output device; and means for receiving the portions of the second set of data and retransmitting the portions of the second set of data to a second output device.

122. Apparatus according to any of claims 113 to 121 further comprising means for receiving the portions of the first set of data and streaming the portions of the first set of data in real time to a first output device.

123. Apparatus according to claim 122 further comprising means for receiving the portions of the second set of data and streaming the portions of the second set of data in real time to a second output device.

124. Apparatus according to any of claims 113 to 123 further comprising means for outputting portions of the first set of data on a first output device, and simultaneously outputting portions of the second set of data on a second output device, so as to give the impression to a user that the portions of the first set of data and the portions of the second set of data are received simultaneously.

125. Apparatus according to any of claims 113 to 123 further comprising means for receiving and outputting a first portion of the first set of data on an output device, and subsequently receiving and outputting a second portion of the first set of data on the output device, such that there is a continuous output of the first set of data on the output device.

126. Apparatus for distributing data to a plurality of control units, the apparatus comprising means for distributing a first set of data and a second set of data to a first one of the control units by apparatus according to any of claims 113 to 125; and means for distributing a third set of data and a fourth set of data to a second one of the control units by apparatus according to any of claims 113 to 125.

127. Apparatus for distributing data comprising means for transmitting first and second sets of data from a central hub to a plurality of local servers; means for storing the first and second sets of data at each local server; and means for distributing the first and second sets of data from at least one of the local servers by apparatus according to any of claims 113 to 124.

128. Apparatus according to any of claims 113 to 126, wherein the first set of data is internet data.

129. A computer program adapted to carry out a method according to any of claims 92 or 94 to 108.

130. A computer readable medium having stored thereon a computer program according to claim 129.

131. A system or apparatus substantially as described herein with reference to the accompanying drawings.

132. A server substantially as described herein with reference to the accompanying drawings.

133. A local control unit substantially as described herein with reference to the accompanying drawings.

134. A method of managing a communication session substantially as described herein with reference to one or more of Figures 1 to 11 of the accompanying drawings.

135. A system according to any of claims 1 to 54, comprising a plurality of mediating means, wherein each of the plurality of mediating means is located at one of a plurality of different locations.

136. A system according to claim 135, wherein the different locations are different locations within a local network.

137. A system according to claim 135 or 136, wherein the different locations are different locations within a building or a vessel.

138. A system according claim 135 or 136, wherein the different locations are different dwellings in a neighbourhood.

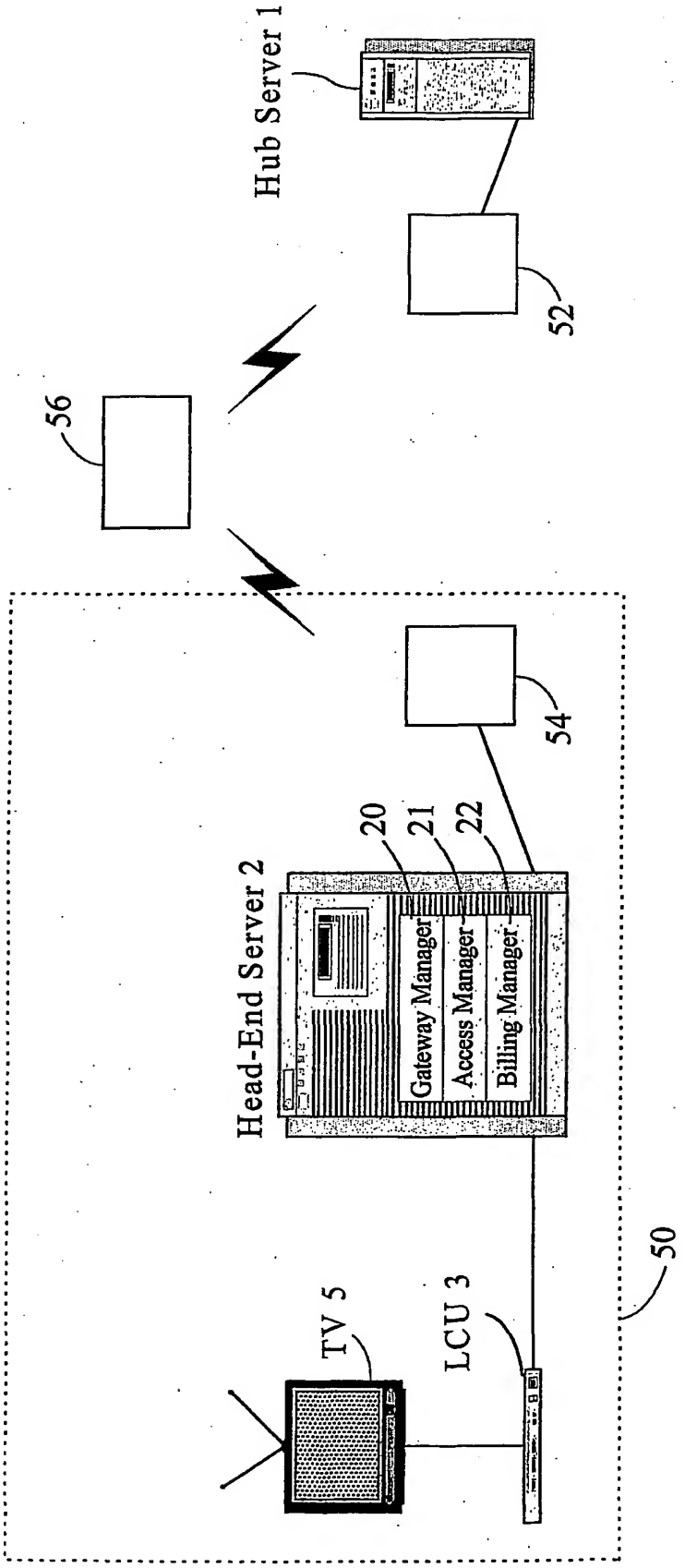
139. A system according to claim 135 or 136, wherein the different locations are different locations within a hospitality environment.

140. A system according to claim 135 or 136, wherein the different locations are different rooms, suites or areas in an educational facility, a caring facility, a medical facility, a detention facility, an entertainment facility, a recreational facility, a hospitality facility, an

office facility, a transport facility or any other facility including establishments, buildings or vessels where one group of people attends to another group.

141. A system according to claim 135 or 136, wherein the different locations are different rooms, suites or areas in a school, university, care home, hospital, cinema, hotel, restaurant, (cruise) ship, or office; or different cells in a prison.

Fig. 1



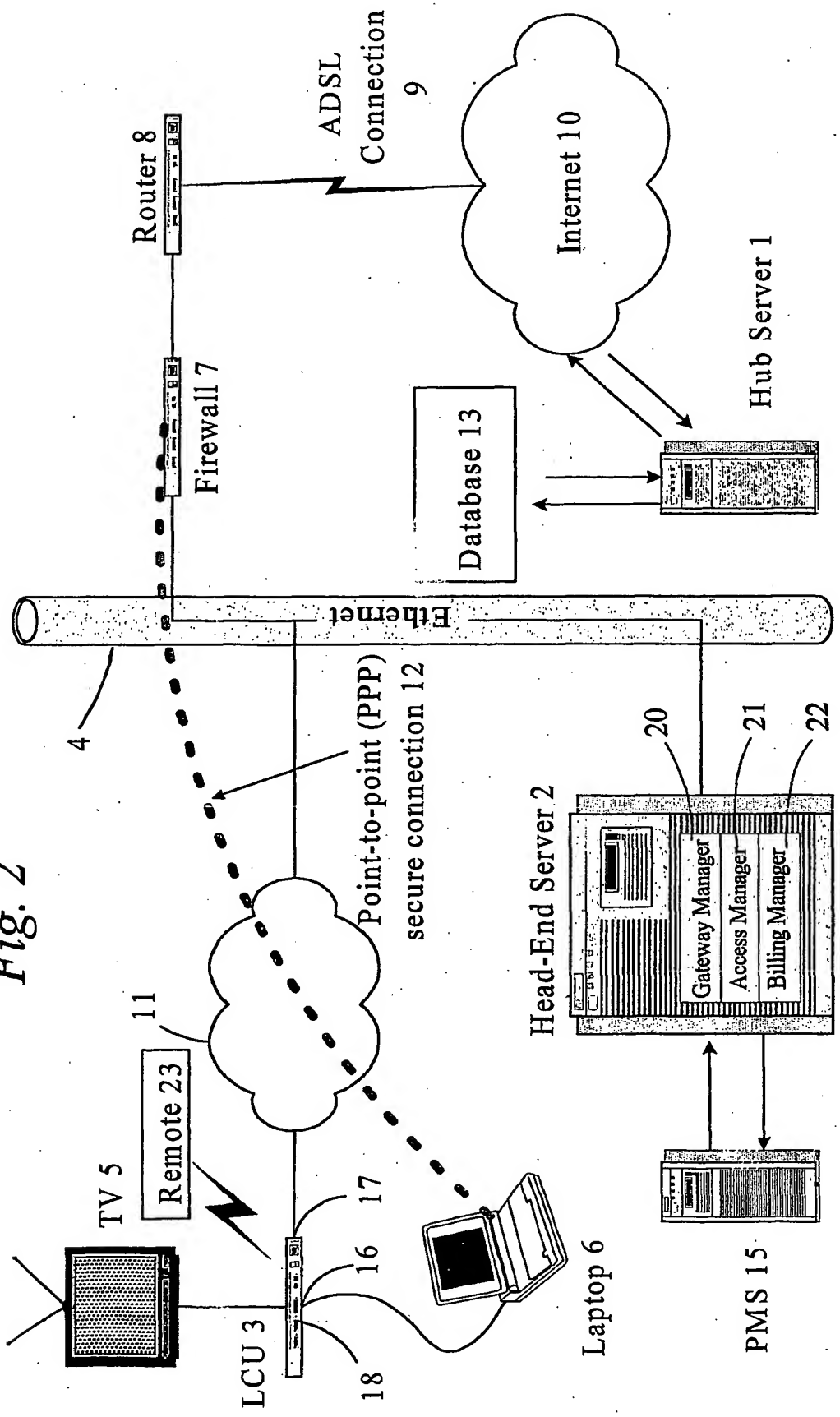



Fig. 2

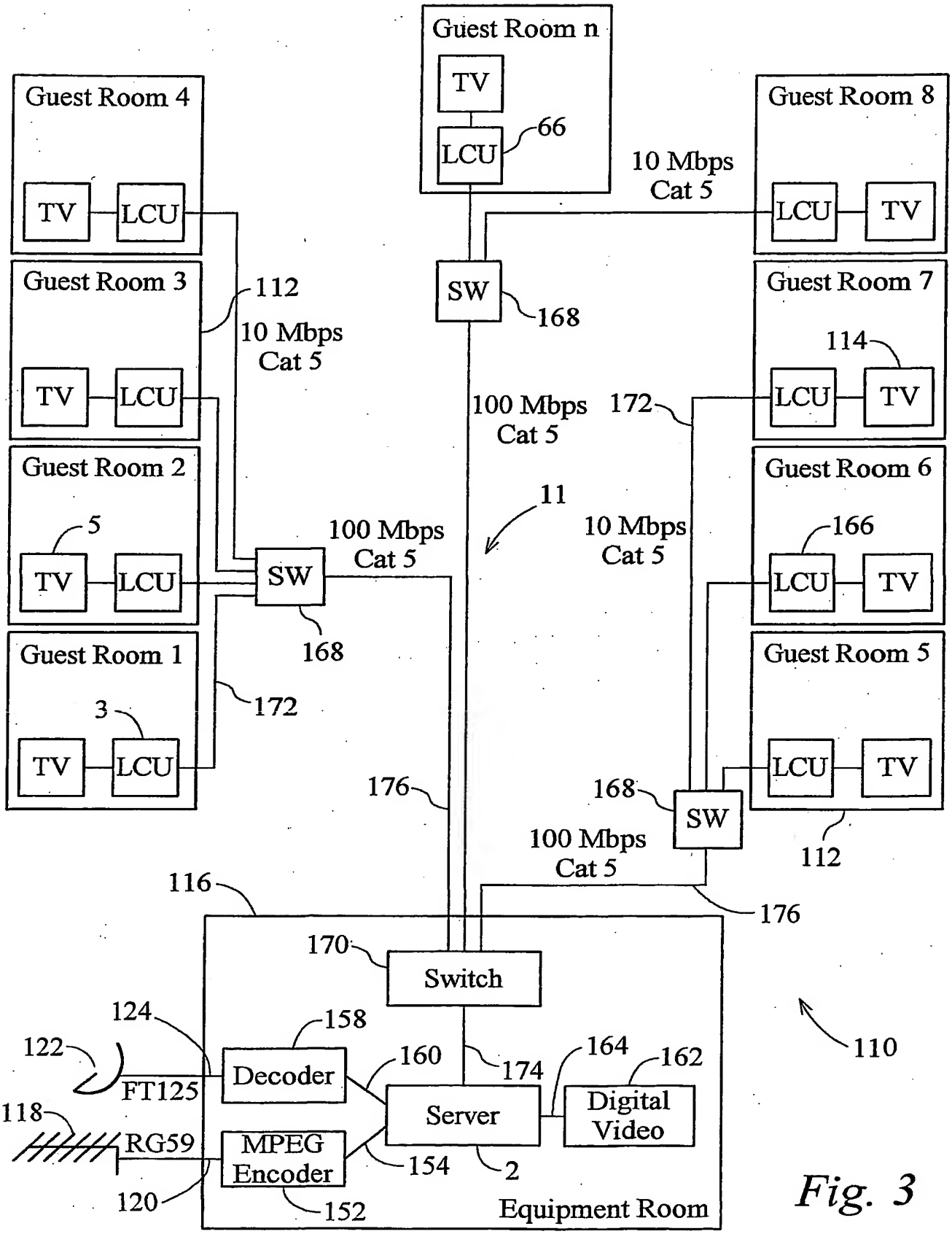



*Fig. 3*

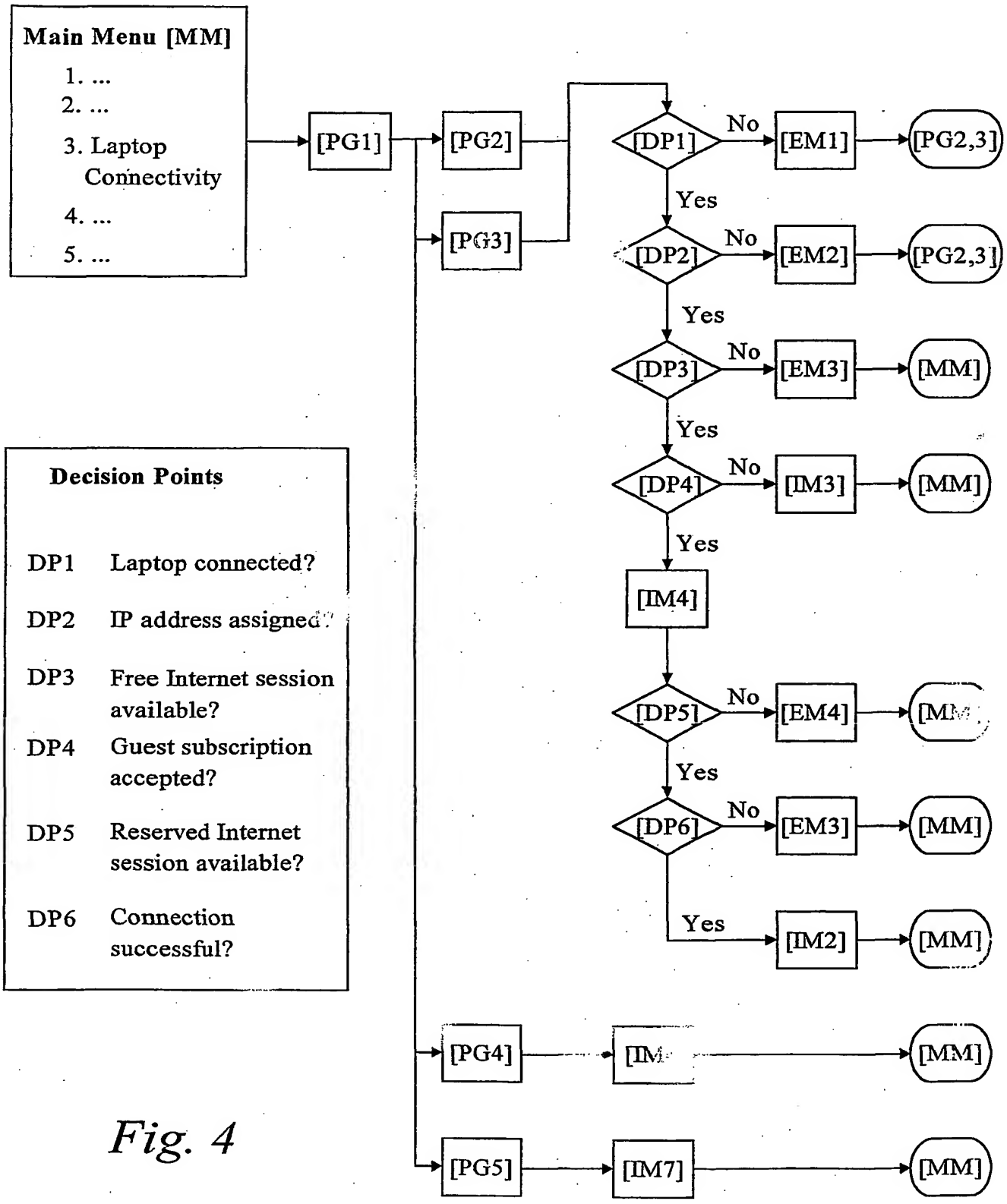



*Fig. 4*

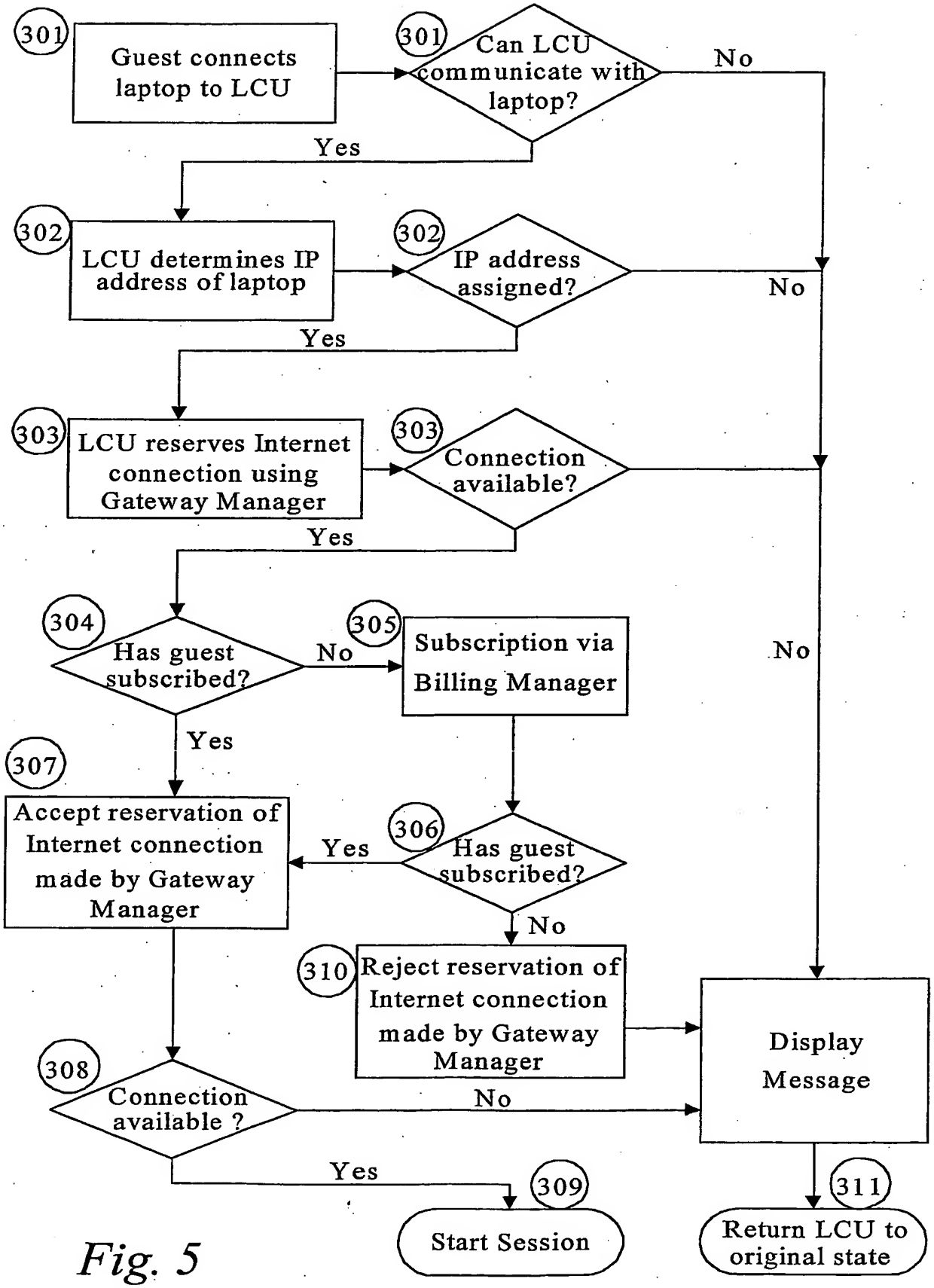



*Fig. 5*

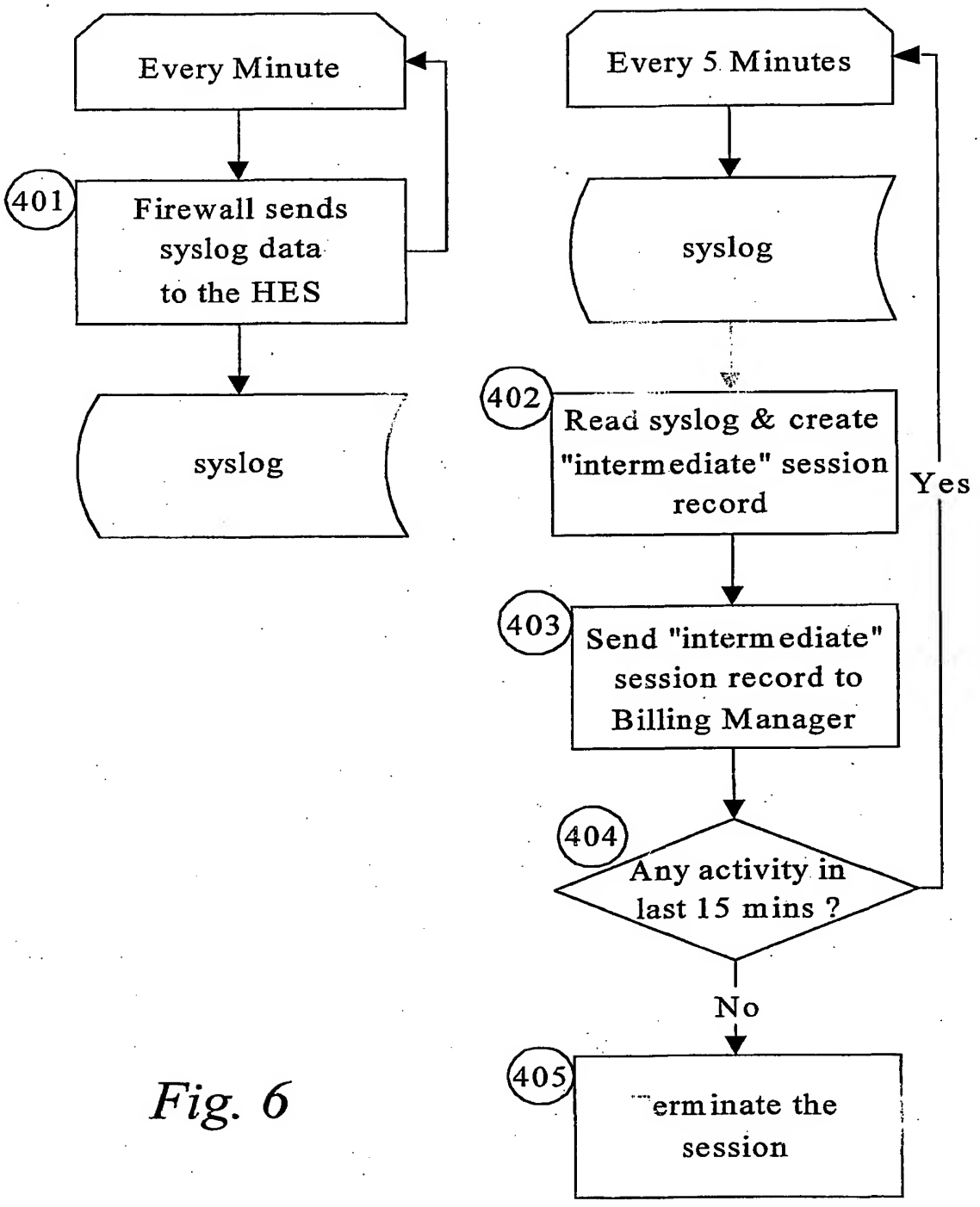



*Fig. 6*

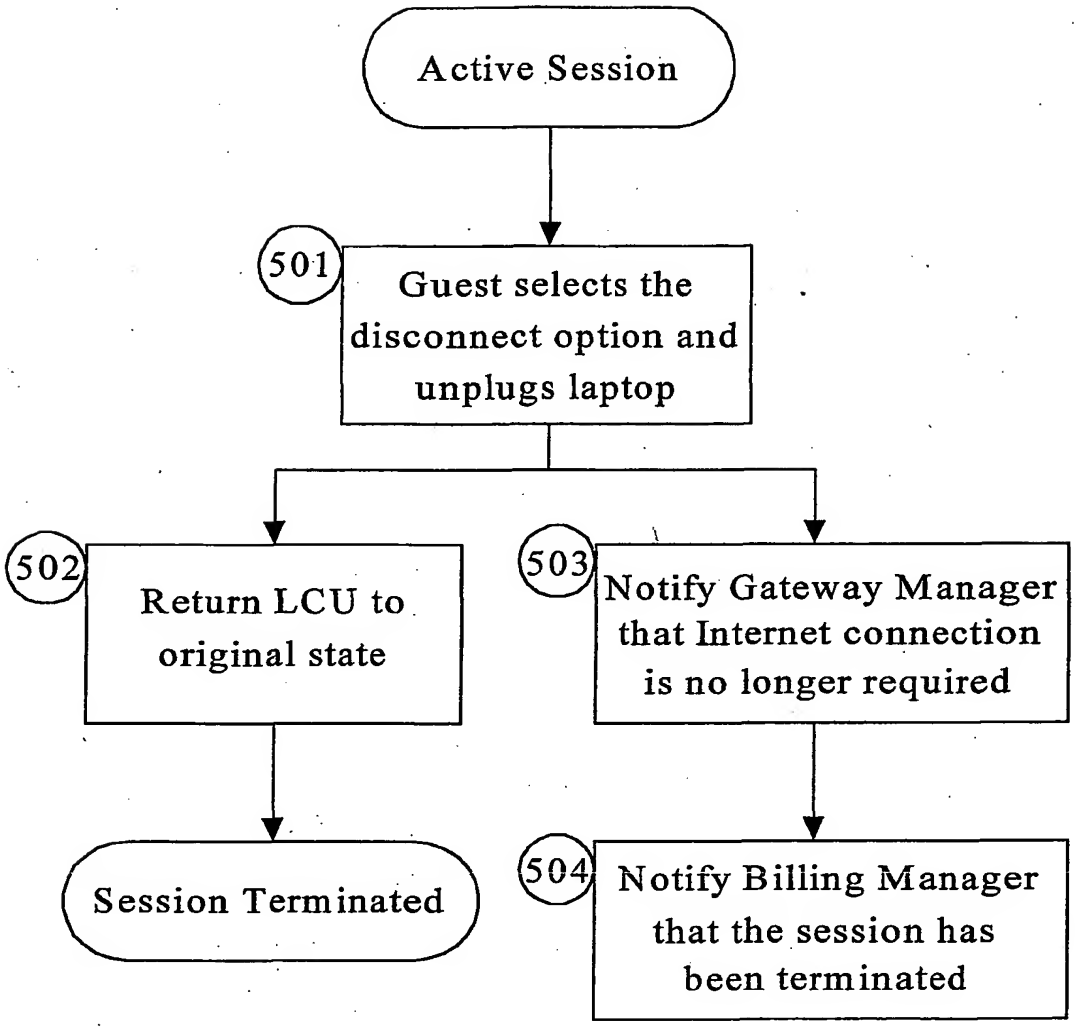



*Fig. 7*

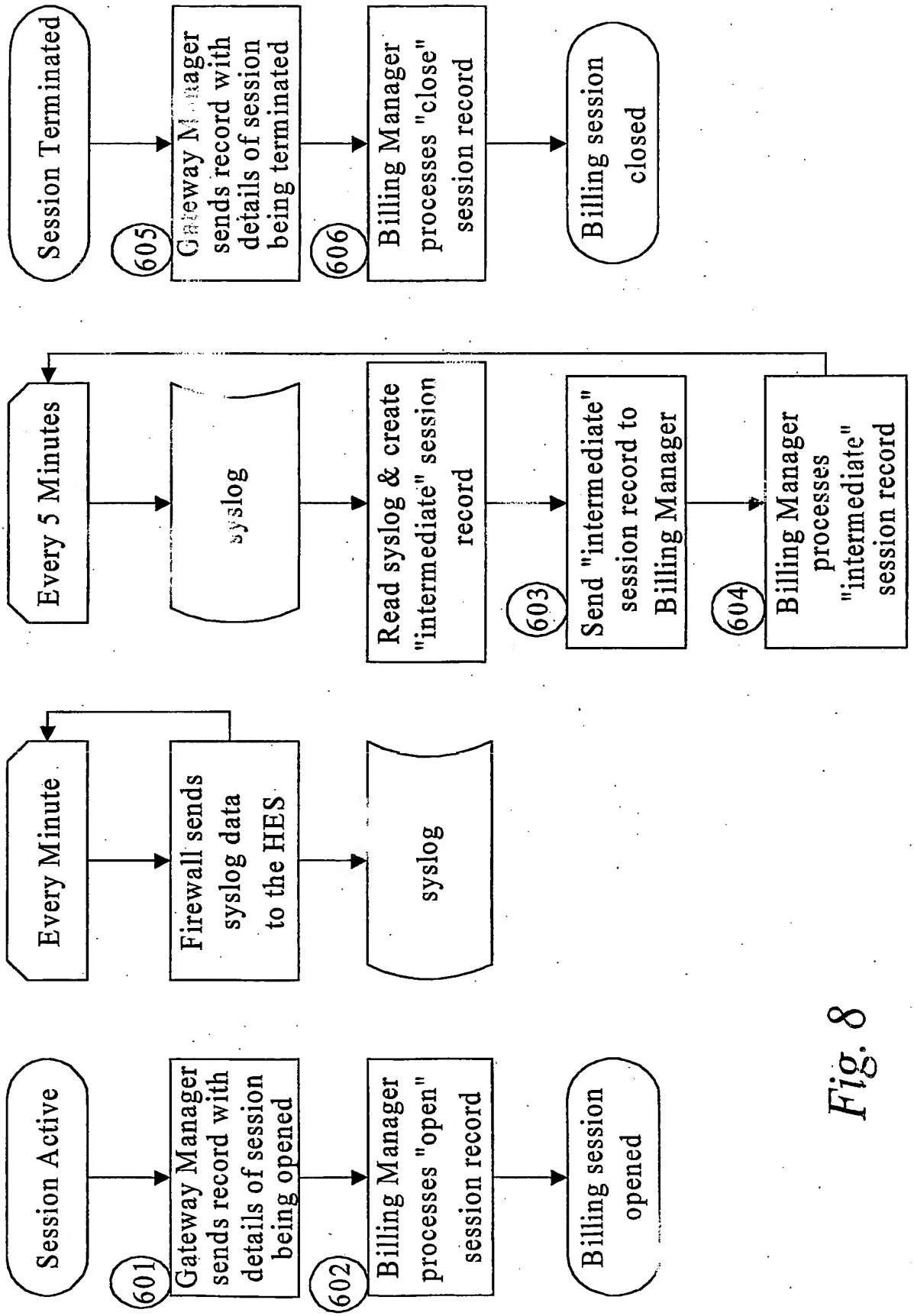



*Fig. 8*

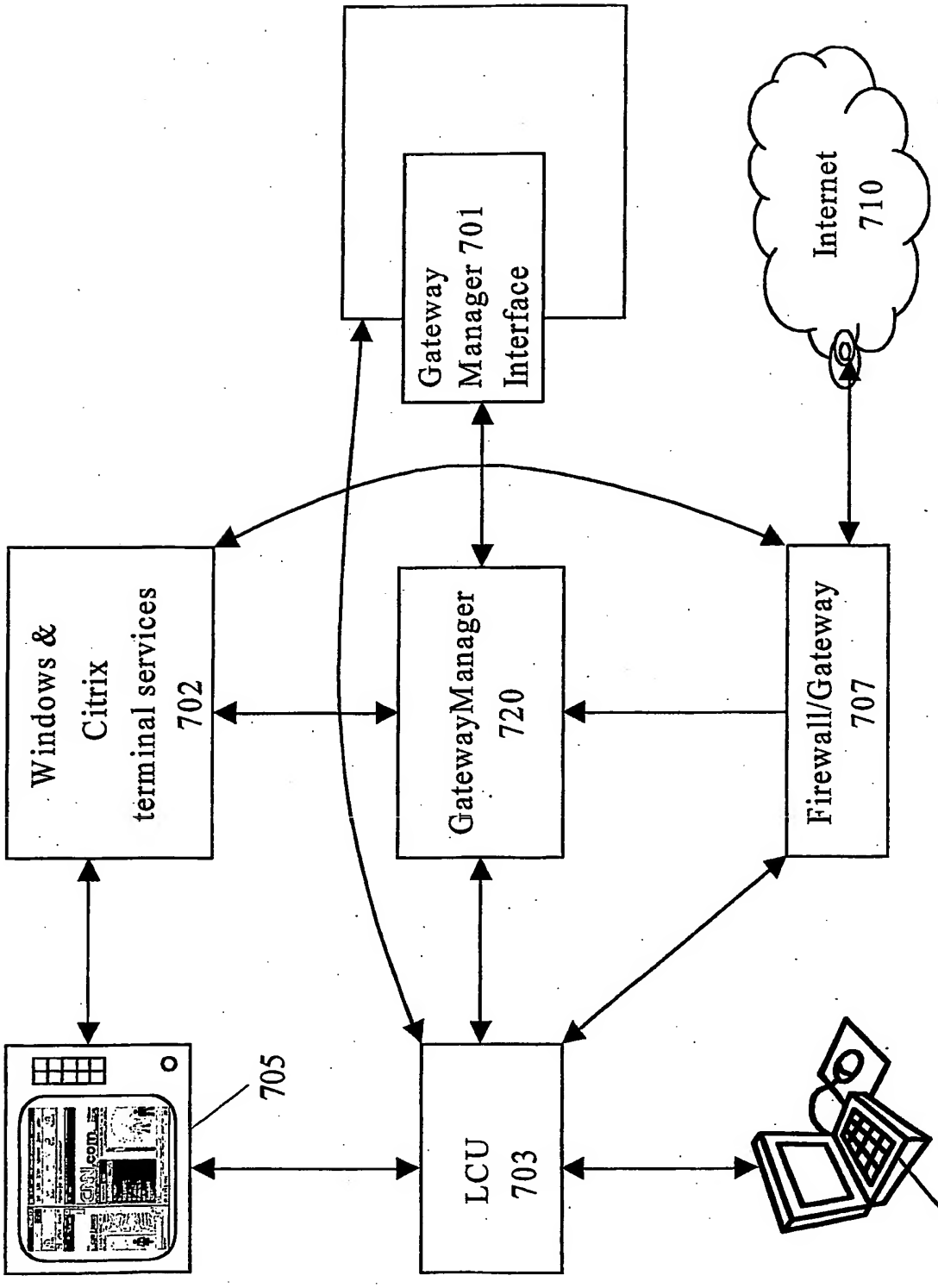



Fig. 9

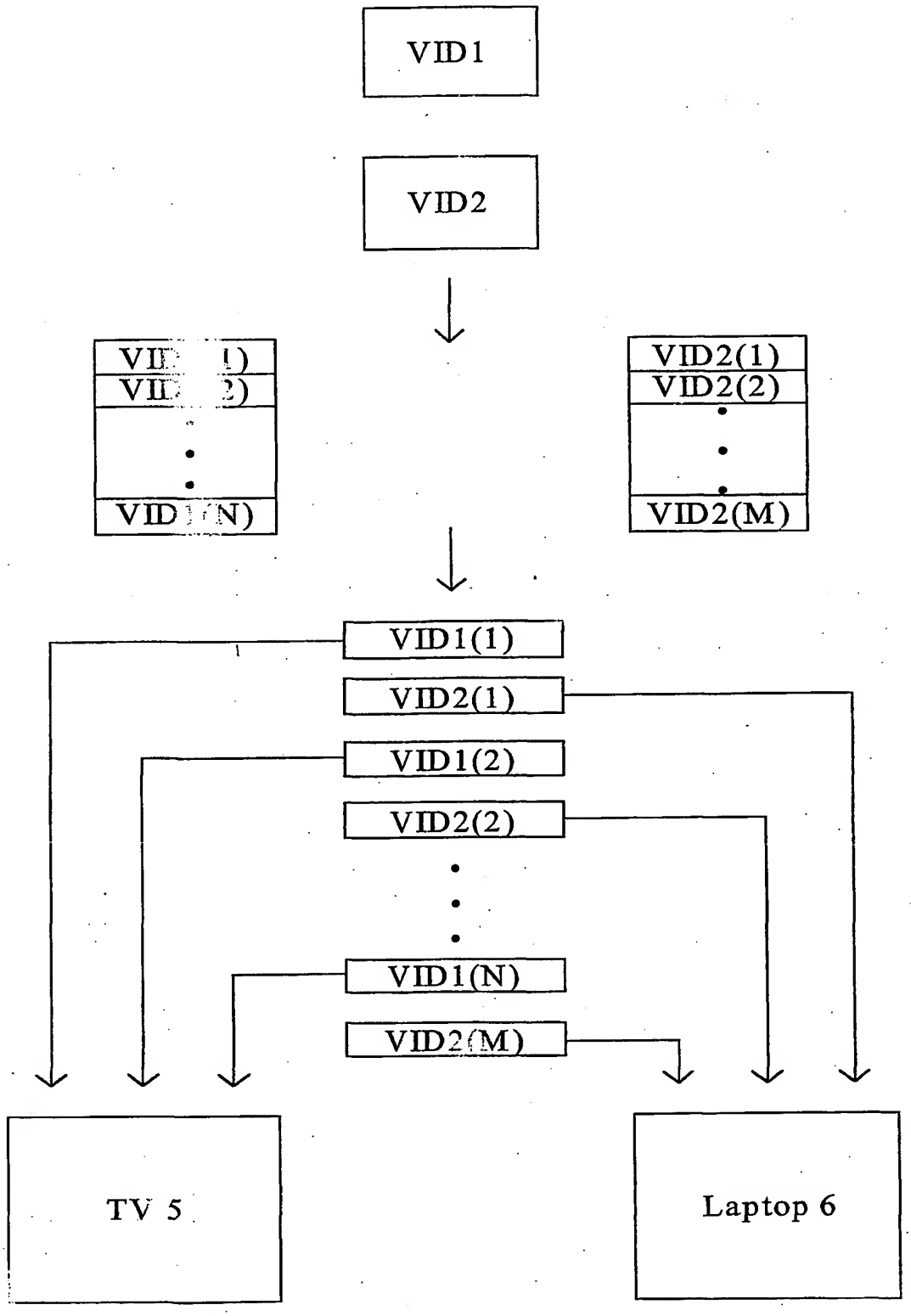



*Fig. 10*

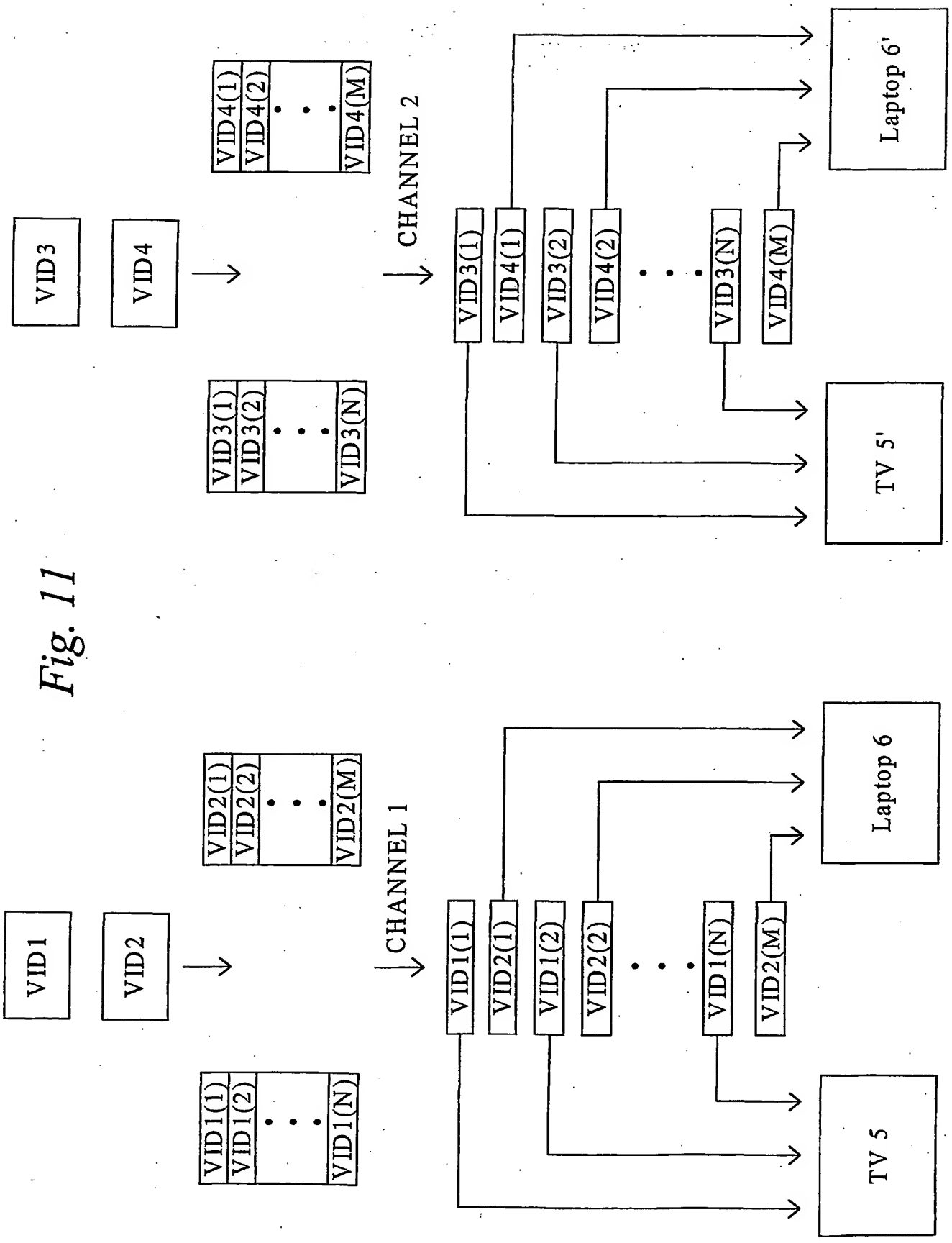



Fig. 11

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(81) Designated States *(national)*: AE, AG, AL, AM, AT (utility model), AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ (utility model), CZ, DE (utility model), DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK (utility model), SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

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WO 02/065705 A2

# PATENT COOPERATION TREATY

# PCT

DECLARATION OF NON-ESTABLISHMENT OF INTERNATIONAL SEARCH REPORT

(PCT Article 17(2)(a), Rules 13ter.1(c) and Rule 39)

| Applicant's or agent's file reference | IMPORTANT DECLARATION | Date of mailing *(day/month/year)* |
|---|---|---|
| PC/TEH/24060 | | 15/08/2002 |
| International application No. | International filing date *(day/month/year)* | (Earliest) Priority date *(day/month/year)* |
| PCT/GB 02/00596 | 11/02/2002 | 09/02/2001 |
| International Patent Classification (IPC) or both national classification and IPC | H04L 29/00 | |
| Applicant | | |
| QUADRIGA TECHNOLOGY LIMITED | | |

This International Searching Authority hereby declares, according to Article 17(2)(a), that **no international search report will be established** on the international application for the reasons indicated below

1. ☐ The subject matter of the international application relates to:
   - a. ☐ scientific theories.
   - b. ☐ mathematical theories
   - c. ☐ plant varieties.
   - d. ☐ animal varieties.
   - e. ☐ essentially biological processes for the production of plants and animals, other than microbiological processes and the products of such processes.
   - f. ☐ schemes, rules or methods of doing business.
   - g. ☐ schemes, rules or methods of performing purely mental acts.
   - h. ☐ schemes, rules or methods of playing games.
   - i. ☐ methods for treatment of the human body by surgery or therapy.
   - j. ☐ methods for treatment of the animal body by surgery or therapy.
   - k. ☐ diagnostic methods practised on the human or animal body.
   - l. ☐ mere presentations of information.
   - m. ☐ computer programs for which this International Searching Authority is not equipped to search prior art.

2. ☐ The failure of the following parts of the international application to comply with prescribed requirements prevents a meaningful search from being carried out:
   ☐ the description ☐ the claims ☐ the drawings

3 ☐ The failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions prevents a meaningful search from being carried out:
   ☐ the written form has not been furnished or does not comply with the standard.
   ☐ the computer readable form has not been furnished or does not comply with the standard.

4. Further comments:

see Further Information

| Name and mailing address of the International Searching Authority | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL-2280 HV Rijswijk<br>Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,<br>Fax: (+31-70) 340-3016 | Audrey Rummery |

Form PCT/ISA/203 (July 1998)

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 203

1)In view of the large number and also the wording of the claims presently on file, which render it difficult, if not impossible, to determine the matter for which protection is sought, the present application fails to comply with the clarity and conciseness requirements of Article 6 PCT (see also Rule 6.1(a) PCT) to such an extent that a meaningful search is impossible. Consequently, no search report can be established for the present application.

2)Furthermore, present claims 1-141 relate to an extremely large number of possible apparatus or methods respectively. In fact, the claims contain so many options, that a lack of clarity within the meaning of PCT Article 6 arises to such an extent as to render a meaningful search of the claims impossible.
It is impossible to derive the essential features of the "mediating means" from the description as the features are either "preferably" contained in the mediating means or it is written, that the mediating means "may" contain a feature. It is not even clear if the mediating means are bound to contain a single feature at all.
Consequently, no search report can be established for the present application.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

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